Meeting Materials
Safe Field Alliance (SFA), Synthetic Turf Council (STC),
Recycled Rubber Council (RRC) and The Institute of Recycling Industries (ISRI)

March 22, 2016

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Synthetic Turf COUNCIL

INDUSTRY OVERVIEW

March 22, 2016

Synthetic Turf COUNCIL

501(c)6 Industry Association

210 Active Members

- Turf manufacturers
- Sports field builders/installers
- Equipment Manufacturers
- Independent professionals

OUR MISSION: Committed to community wellness and environmental responsibility through the use of synthetic turf, the Synthetic Turf Council is the industry's voice for promoting the highest ethical and professional standards, education, legislation and community advocacy.

www.syntheticturfcouncil.org

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Industry at a Glance

- Today, there are an estimated 12,000 – 13,000 synthetic turf sports fields in the United States
- Approximately 1,200-1,500 fields are being built each year
- The lifespan of a field is roughly 8 years.
- In 2016, approximately 750 fields are due for replacement and that number grows exponentially on an annual basis.
- It is estimated that 95% of the fields installed utilize recycled rubber infill exclusively or in a mixture with sand or alternative infills.

Synthetic Turf COUNCIL

STC Member Rubber Reprocessors

- 7 Member companies produce ~95%+ of all recycled rubber used as infill
- Voluntary Industry Standards are being followed by all 7 member companies

Recycled Rubber Council
Scrap Tire Industry Overview

March 22, 2016

U.S. Scrap Tire Generation

Tire Class	Millions of PTEs[1]	Weight (tons in 000s)
Light Duty Tires (Passenger / Light Truck)	240	2,640
Commercial Tires (Truck / Bus)	110	1,210
Total Tires Hauled	350	3,850

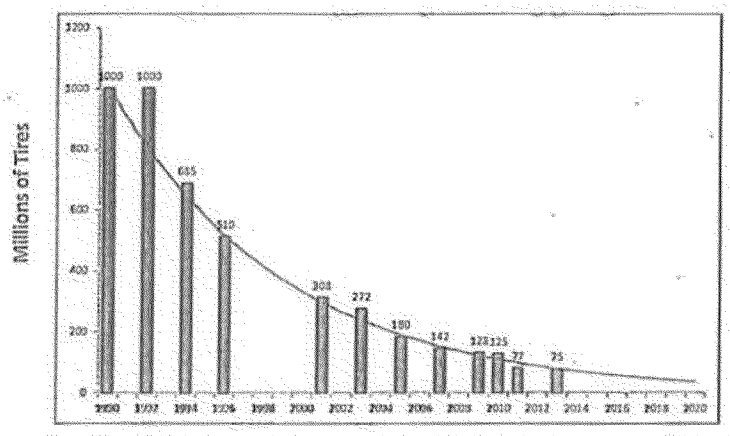
[1]PTEs = Passenger Tire Equivalent (based on 22 lbs. per PTE)

- Scrap tire generation rate relatively consistent over the last few years – tracks population growth & economy
- Commercial Tire category includes truck tire buffings

Based on Recycled Rubber Council 2015 Internal Estimate

RECYCLED RUBBER COUNCIL

U.S. Stockpiled Scrap Tires (1990-2013)



- Meaningful improvement in scrap tire stockpiles has been achieved since 1990

3/22/2016

Rubber Manufacturers 2014: "2013 U.S. Scrap Tire Management Study Summary"

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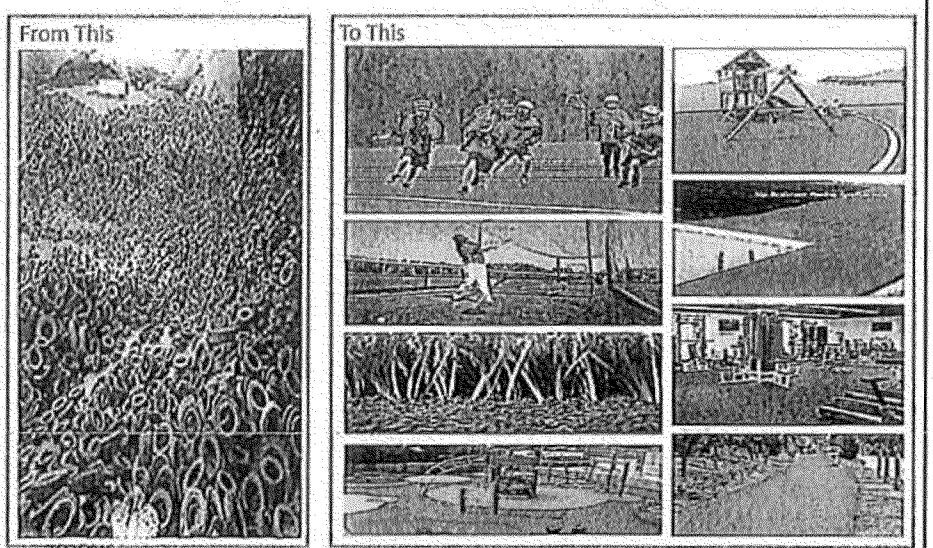
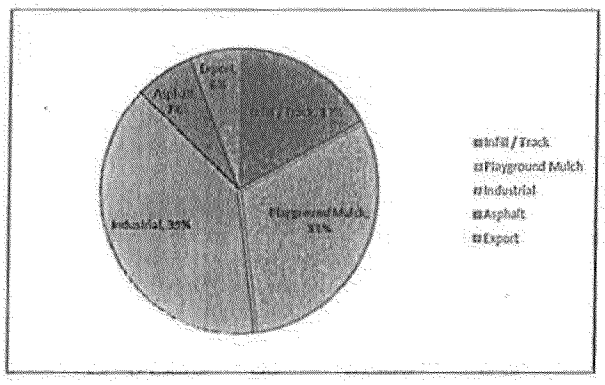
Recycled Rubber in Everyday Use



3/22/2016

RECYCLED RUBBER COUNCIL

U.S. Ground Rubber Market Summary



- Total Ground Rubber market is approximately 1.5B LBS
- Total Scrap Tires diverted to these markets is almost 105M PTEs

Based on Recycled Rubber Council 2015 Internal Estimate

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Tire Reprocessors Supplying the Synthetic Turf Industry*

Alberta Environmental (AERP)
13500 - 156 Street
Edmonton, AB T5V 1L3
Canada
Phone: 780-447-1994

BAS Recycling, Inc.
14050 Day Street
Moreno Valley, CA 92553
United States
Phone: 951-214-6590

CRM Company, LLC - New York
7294 Albany Street
Colonie, NY 12205
United States
Phone: 949-263-9100

Entech Inc
69676 M-103
White Pigeon, MI 49099
United States
Phone: 574-822-9107

Entire Recycling, Inc.
13974 US-136
Rock Port, MO 64482
Phone: 660-744-2252

Genan Inc.
18038 Beaumont Hwy
Houston, TX 77049
United States
Phone: 713-674-8500

Granuband Macon, LLC
612 Blees Industrial Dr
Macon, MO 63552
Phone: 660-385-7156

Liberty Tire Recycling, LLC
1251 Waterfront Place
4th Floor
Pittsburgh, PA 15222
United States
Phone: 412-562-1700

West Coast Rubber Recycling
1501 Lana Way
Hollister, CA 95023
United States
Phone: 831-634-2800

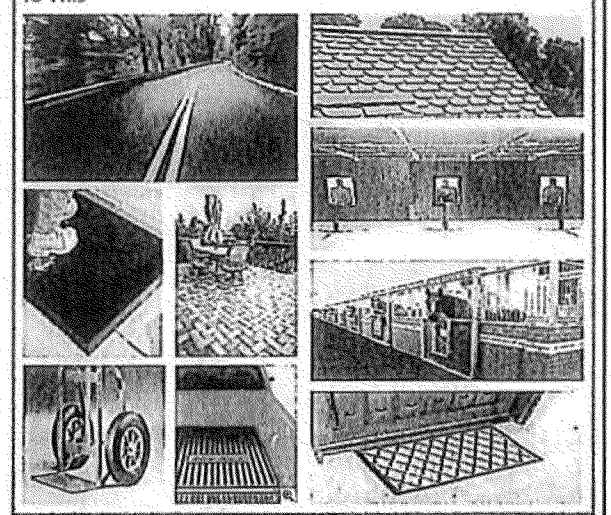
We estimate this group supplies more than 95% of the total market. ENTIRE and GRANUBAND are not members of the Synthetic Turf Council.

RECYCLED RUBBER COUNCIL

Recycled Rubber in Everyday Use

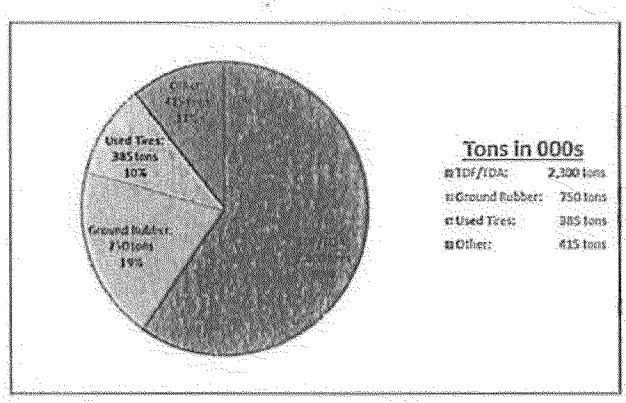
From This

To This



RECYCLED RUBBER COUNCIL

U.S. Scrap Tire Market Summary



- TDF / TDA segment grew high single digits in 2015
- Ground Rubber segment grew high single digits to low double digits in 2015
- Used Tires segment was flat YoY

Based on Recycled Rubber Council 2015 Internal Estimate

Safe Fields Alliance

Synthetic Turf Discussion

Strategic Direction of Industry

Safe Fields Alliance

- Help Parents, Coaches, Communities focus on Science
- Comply with STC Guidelines for recycled rubber in fields

Exposure Compliance vs. Benchmarks

- US EPA Standard for lead in toys and in urban/rural soils
- EN 71-3 EU Toy standard for 18 Heavy metals
- California Human Health Screening Level (CHHSL) guideline for 18 heavy metals
- Prop. 65 standard
- PAH Exposure analysis vs. urban/rural soils

Going beyond exposure monitoring

- Brown University study examining carcinogenic and tumor promoting effects of crumb rubber

Background

Safe Fields Alliance

"Infilled" artificial turf was introduced in the mid 90's and revolutionized sport, replacing the old "carpet style" turf systems.

Since then, over 10,000 fields have been installed in North America, including:

- 13 NFL Teams
- 2 Major League Baseball Teams
- 4 MLS Teams
- Over 100 NCAA Teams, of all sports
- Thousands of high schools and communities

Turf Construction

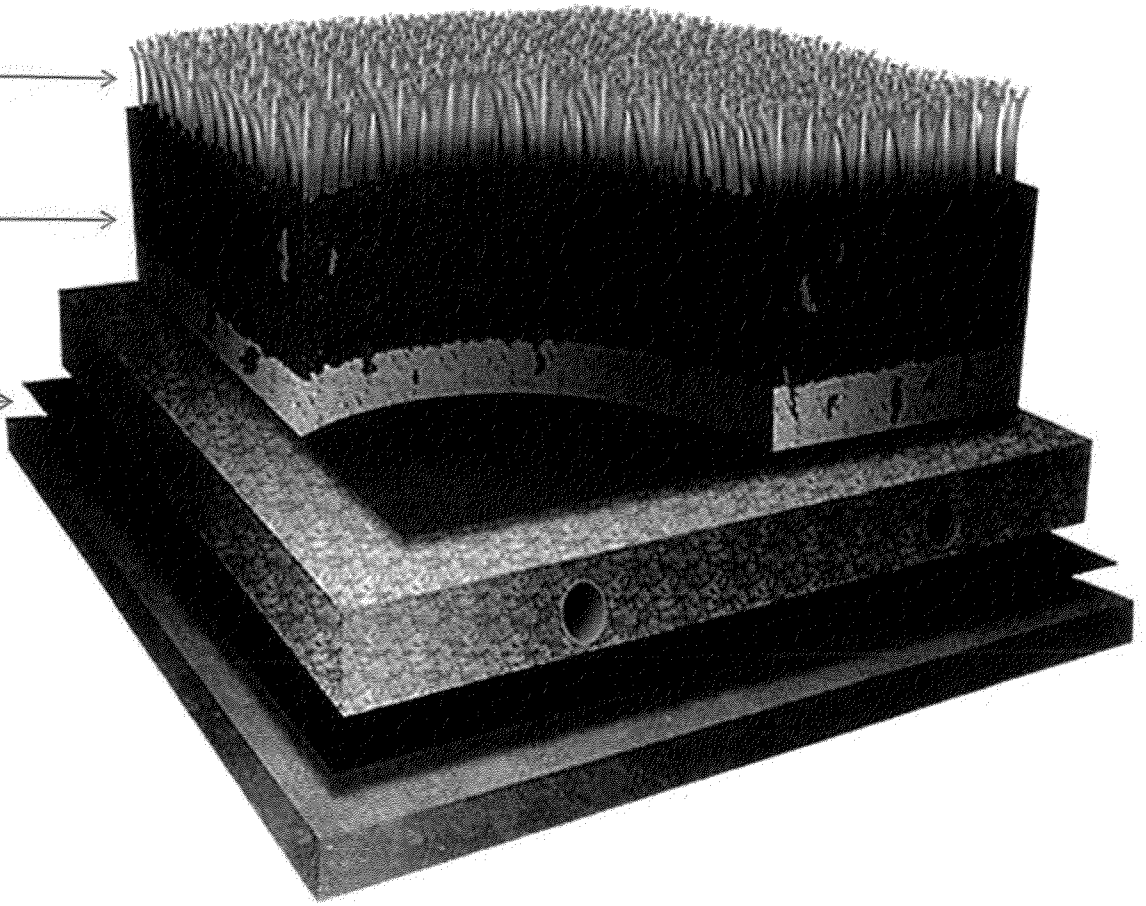
Safe Fields Alliance

Turf: Polyethylene Fibers tufted into multi-layered Polypropylene backing, urethane secondary backing for tuft bind and dimensional stability

Infill: 10/20 mesh (approx. 1.5mm) recycled rubber

- Nike Grind
- Organic Infills
- Virgin Resins

Base: Stone/Drainage with or without pad



Benefits of Crumb Rubber

Safe Fields Alliance

High Performance	• Meets stringent performance standards established by the NFL and FIFA.
High Durability	• Ultimate compression / compaction over time. • Can be re-used for (at least) the life of two fields.
Availability	• Numerous sources across America.
Environmentally Friendly	• Each field uses 20,000 recycled tires, • Material can be re-used.

Industry Standards

Safe Fields Alliance

The Crumb Rubber Infill (CRI) used in artificial turf fields shall be derived from North American whole, vulcanized automobile, SUV, and light truck tires.

Tires more than 7 years old from date of production are not allowed.

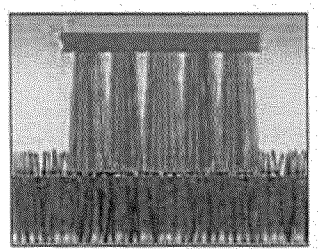
No factory tire rejects or recalled tires are allowed.

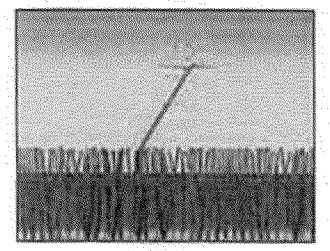
The CRI material shall be essentially contaminate free and shall be a minimum of 99.9% crumb rubber.

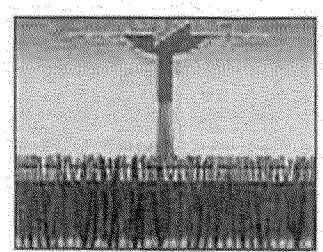
General Maintenance Practices

Safe Fields Alliance

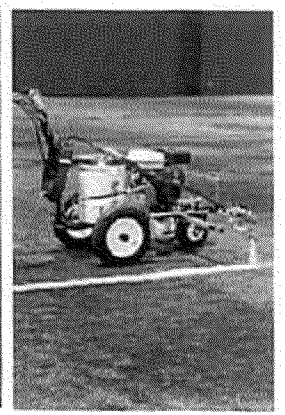
- Routine maintenance
  - Brushing – infill redistribution
  - Raking – infill decompaction
  - Sweeping – Debris removal


Brushing


Raking


Sweeping

- Additional Maintenance
  - Re-filling high use areas
  - Painting (on some fields)



General Maintenance Practices Continued

Safe Fields Alliance

Does infill need to be added to a turf field?

- No.

Do chemicals need to be used to clean the turf?

- Not on a regular basis.
- Some customers will use scrub / cleaners, but just like natural grass, mother nature is the best cleaner.
- Work done at Penn State University has shown that there is less bacteria in artificial turf versus natural grass.

Alternatives to Rubber

Safe Fields Alliance

Alternative Options

- Organics (Portugal / Africa)
- TPE (Germany / Italy)
- Nike Grind (Asia)
- Zeolite (USA)

Tradeoffs

- Unproven Performance / History
- Untested (no safety data)
- International Waste
- Irrigation Required
- Higher Costs

Summary

Safe Fields Alliance

Recycled rubber for fields is produced by mechanically crumbling tires with no chemicals added

Recycled rubber is the safest, most durable infill system that acts as a reliable "safety layer"

- Alternatives are largely untested, mostly imported, questionable longevity
- Recycled rubber removes tires from landfills, most alternates are imported and add to our landfills

Summary Continued

Safe Fields Alliance

Recycled rubber complies with relevant toxicology guidelines for toys, soils, heavy metals, PAH's etc. The margin of compliance is often significant

In addition to regulatory guidelines, industry has adopted voluntary guidelines for use of recycled rubber in fields

By studying the carcinogenic and tumor preventing effects of recycled rubber, the Brown study uses proven methodology to provide a unique perspective

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Recycled Rubber Infill Technical Research

Summary of Findings

3/22/2016

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Significant Body of Knowledge

More than **90** technical studies and reports since 1990

- **26** by universities and research institutes
- **44** by city, state and federal governments
- **22** representing consolidated reports of prior studies

Considering multiple **bioavailability pathways and outcomes**

- **34** inhalation
- **45** ingestion
- **27** dermal contact
- **11** cancer

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Significant Body of Experts

Chemists and chemical engineers
Toxicologists
Epidemiologists
Biologists
Other medical professionals

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Compelling Results

Broad-based studies have:

unequivocally failed to find any link between recycled rubber infill and cancer or any other human health risk.

All have concluded that:

recycled rubber infill does not pose an elevated human health risk to people of any age.

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Examples from Work to Date

The STC believes that reliable scientific data should be the foundation of any discussion regarding the safety of synthetic turf with crumb rubber infill:

"The use of outdoor and indoor artificial turf fields is not associated with elevated health risks."

Connecticut Department of Public Health, *Human Health Risk Assessment of Artificial Turf Fields Based upon Results from Five Fields in Connecticut*, 2010

"Many governmental bodies including Norway, Sweden and California have recently reviewed the health issues associated with the use of crumb rubber as infill at playgrounds and synthetic turf fields. Their assessments did not find a public health threat."

Ly Lim, Ph.D., P.E., *A Study to Assess Potential Environmental Impacts from the Use of Crumb Rubber as Infill Material in Synthetic Turf Fields*, New York State Department of Environmental Conservation, June 2008

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Ingestion, Inhalation, Dermal Contact

"Eleven different risk assessments applied various available concentrations of COPCs [chemical of potential concern] and none identified an increased risk for human health effects as a result of ingestion, dermal or inhalation exposure to crumb rubber."

A Review of the Potential Health and Safety Risks from Synthetic Turf Fields Containing Crumbs Rubber Infill, New York City Department of Health and Mental Hygiene, May 2008

"Based on the available literature on exposure to rubber crumb swallowing, inhalation and skin contact...we conclude that there is not a significant health risk due to the presence of rubber infill for football players (for) an artificial turf pitch with rubber infill from used car tires."

U. Hofstra, *Environmental and Health Risks of Rubber Infill: Rubber Crumb from Car Tires as Infill on Artificial Turf*, 2007

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Risk of Cancer

"Genotoxicity testing of tire crumb samples ... suggests that ingestion of small amounts of tire crumb by small children will not result in an unacceptable hazard of contracting cancer."

Detlef A. Birkholz, Kathy L. Belton, Tee L. Guidotti, *Toxicological Evaluation for the Hazard Assessment of Tire Crumb for Use in Public Playgrounds*, J. Air & Waste Management Association, 53:903–907, July 2003

"Ingestion of a significant quantity of tire shred did not elevate a child's risk of developing cancer, relative to the overall cancer rate of the population."

Rachel Simon, University of California, Berkeley, Review of the Impacts of Crumb Rubber in Artificial Turf Applications, February 2010

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Summary

Where do we go from here?

- Many studies have been performed on the health and safety risks of recycled rubber infill, and the findings to date are clear
- But STC supports future opportunities for independent, science-based research
- We are confident that further work will corroborate findings to date

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EXECUTIVE SUMMARY
CATALOG OF AVAILABLE RECYCLED RUBBER RESEARCH
March 3, 2016

In early 2015, in response to increased public interest in the potential health effects of synthetic turf sports fields with recycled rubber infill, the Synthetic Turf Council began compiling a list of available studies and making them more readily accessible to the public.

Since 1990, STC has identified more than 90 technical studies and reports that have delved into various health and human safety questions relating to the use of recycled rubber as an aftermarket product, including its use as infill in synthetic turf sports fields. These studies have involved chemical engineers, toxicologists, epidemiologists, chemists, biologists and other medical professionals. They have estimated whether toxins are present at any level of concern, whether the human body can access them, and if exposure over time increases risk. The majority of the studies were conducted independently by academic institutions and government agencies.

This compelling body of knowledge (to date) includes:

- 34 considering inhalation toxicity
- 45 considering ingestion toxicity
- 27 considering dermal toxicity
- 11 considering links to cancer
- 26 conducted by universities and research institutes
- 29 conducted by city and state agencies
- 15 conducted by US and foreign federal government agencies
- 22 representing consolidated reports of previous studies

This broad-based body of scientific research from academic, independent third party, federal and state government organizations has **unequivocally failed to find any link between recycled rubber infill and cancer or any other human health risk.**

There can always be more research done, and the Synthetic Turf Council encourages and supports any future opportunities for independent, science-based research. We are confident that additional research will corroborate findings to date; namely, that recycled rubber infill does not pose an elevated human health risk to people of any age.

The Synthetic Turf Council and its members are dedicated to providing safe and durable synthetic turf products to millions of users across the country. Since 2007, an estimated 4.5 billion square feet of synthetic turf have been installed around the world, including 800 million square feet in the U.S. Recycled rubber infill is used in over 98% of the 12,000+ synthetic turf sports fields, providing superior shock absorption, traction, foot stability and safety to millions of athletes. These sports field systems also benefit sustainability efforts by: conserving water, reducing fertilizers, pesticides and herbicides, and diverting millions of tires from landfills.

To learn more, a summary of findings, as well as links to all of these studies, can be found on the STC website at: http://www.syntheticturfcouncil.org.

Independent Research

Science is an important focus for the STC. That's why we actively collect independent research and studies from third-party organizations about synthetic turf and its system components under the following topics: *Player Performance & Risk of Injury; Environmental & Health Risk of Synthetic Turf with Crumb Rubber Infill; Heat; Staph & MRSA*

Jump to topic (click on link below):

Player Performance & Risk of Injury »

Playing Surface Technical Analysis 3

FIFA, Prozone Study, 2011

- This is the third study FIFA has commissioned to analyze and compare player performance during games played on top quality synthetic turf and grass. All three studies and other FIFA research are available here: http://www.fifa.com/aboutfifa/footballdevelopment/pitchequipment/footballturf/testsresearch/studies.htn
- Conclusions: These studies found that no significant differences exist between team and player performance on football [synthetic] turf and natural grass.

Epidemiology of Patellar Tendinopathy in Elite Male Soccer Players

Hagglund, M., PT, PhD; Zwerver, J., MD, PhD; Ekstrand, J., MD, PhD, American Journal of Sports Medicine, June 2011, 0363546511408877

- Patellar tendinopathy is a relatively mild but fairly common condition among elite soccer players, and the recurrence rate is high.
- This study investigated the epidemiology of patellar tendinopathy in 2,229 elite male soccer players from 51 European elite soccer clubs playing on natural grass and synthetic turf between 2001 and 2009.Objective: To compare the risk for acute injuries between natural grass (NG) and third-generation artificial turf (3GAT) in male professional football.

- Conclusion: "Exposure to artificial turf did not increase the prevalence or incidence of injury."

Risk of Injury on Third Generation Artificial Turf in Norwegian Professional Football

Bjørneboe J, Bahr R, Andersen TE, 2010 British Journal of Sports Medicine, 44: 794-798.

- Methods: All injuries sustained by players with a first-team contract were recorded by the medical staff of each club, from the 2004 throughout the 2007 season. An injury was registered if the player was unable to take fully part in football activity or match play.
- Results: A total of 668 match injuries, 526 on grass and 142 on artificial turf, were recorded. The overall acut match injury incidence was 17.1 (95% CI 15.8 to 18.4) per 1000 match hours; 17.0 (95% CI 15.6 to 18.5) on grass and 17.6 (95% CI 14.7 to 20.5) on artificial turf. Correspondingly, the incidence for training injuries was 1.8 (95% CI 1.6 to 2.0); 1.8 (95% CI 1.5 to 2.0) on grass and 1.9 (95% CI 1.5 to 2.2) on artificial turf respectively. No significant difference was observed in injury location, type or severity between turf types.
- Conclusion: No significant differences were detected in injury rate or pattern between 3GAT and NG in Norwegian male professional football.

Comparison of Injuries Sustained on Artificial Turf and Grass by Male and Female Elite Football Players

Ekstrand J, Hägglund M, Fuler CW, 2010, Scandinavian Journal of Medicine and Science in Sports, DOI: 10.1111/j.1600-0838.2010.01118.x

- The objective of this study was to compare incidences and patterns of injury for female and male elite teams when playing football on artificial turf and grass. Twenty teams (15 male, 5 female) playing home matches on third-generation artificial turf were followed prospectively; their injury risk when playing on artificial turf pitches was compared with the risk when playing on grass. Individual exposure, injuries (time loss) and injury severity were recorded by the team medical staff. In total, 2105 injuries were recorded during 246000h of exposure to football. Seventy-one percent of the injuries were traumatic and 29% overuse injuries. There were no significant differences in the nature of overuse injuries recorded on artificial turf and grass for either men or women. The incidence (injuries/1000 player-hours) of acute (traumatic) injuries did not differ significantly between artificial turf and grass, for men (match 22.4 v 21.7; RR 1.0 (95% CI 0.9–1.2); training 3. v 3.5; RR 1.0 (0.8–1.2)) or women [match 14.9 v 12.5; RR 1.2 (0.8–1.8); training 2.9 v 2.8; RR 1.0 (0.6–1.7)]. During matches, men were less likely to sustain a quadriceps strain (P=0.031) and more likely to sustain an ankle sprain (P=0.040) on artificial turf.

Injury Risk on Artificial Turf and Grass in Youth Tournament Football

Soligard T, Bahr R, Andersen TE, 2010, Scandinavian Journal of Medicine and Science in Sports, DOI: 10.1111/j.1600-0838.2010.01174.x

- The aim of this prospective cohort study was to investigate the risk of acute injuries among youth male and female footballers playing on third-generation artificial turf compared with grass. Over 60000 players 13–19 years of age were followed in four consecutive Norway Cup tournaments from 2005 to 2008. Injuries were recorded prospectively by the team coaches throughout each tournament. The overall incidence of injuries was 39.2 (SD: 0.8) per 1000 match hours; 34.2 (SD: 2.4) on artificial turf and 39.7 (SD: 0.8) on grass. After adjusting for the potential confounders age and gender, there was no difference in the overall risk of injury [odds ratio (OR): 0.93 (0.77–1.12), P=0.44] or in the risk of time loss injury [OR: 1.05 (0.68–1.61), P=0.82]

between artificial turf and grass. However, there was a lower risk of ankle injuries [OR: 0.59 (0.40–0.88), P=0.008], and a higher risk of back and spine [OR: 1.92 (1.10–3.36), P=0.021] and shoulder and collarbone injuries [OR: 2.32 (1.01–5.31), P=0.049], on artificial turf compared with on grass. In conclusion, there was no difference in the overall risk of acute injury in youth footballers playing on third-generation artificial turf compared with grass.

Very Positive Medical Research on Artificial Turf

Turf Roots Magazine 01, pp. 8-10
www.fifa.com

- A report of medical research conducted by FIFA's Medical Assessment and Research Centre (F-MARC) comparing injuries sustained at the FIFA U-17 tournament in Peru, which was played entirely on "football turf" (synthetic turf) with the injuries sustained at previous U-17 tournaments, which were played mainly on well-manicured grass. "The research showed that there was very little difference in the incidence, nature and causes of injuries observed during those games played on artificial turf compared with those played on grass.

Risk of Injury on Artificial Turf and Natural Grass in Young Female Football [Soccer] Players

Kathrin Steffen, Thor Einar Andersen, Roald Bahr
British Journal of Sports Medicine 2007; 41:i33-i37
http://bjsm.bmj.com

- Objective: "To investigate the risk of injury on artificial turf compared with natural grass among young female football [soccer] players."
- Conclusion: "In the present study among young female football [soccer] players, the overall risk of acute injur was similar between artificial turf and natural grass."

Comparison of the Incidence, Nature and Cause of Injuries Sustained on Grass and New Generation Artificial Turf by Male and Female Football Players

Colin W Fuller, Randall W Dick, Jill Corlette, Rosemary Schmalz
British Journal of Sports Medicine 2007; 41 (Supplement 1):i20-i26 (Part 1: match injuries)
British Journal of Sports Medicine 2007; 41 (Supplement 1):i27-i32 (Part 2: training injuries)
Abstracts available at **http://bjsm.bmj.com**

- Objective: "To compare the incidence, nature, severity and cause of match injuries (Part 1) and training injuries (Part 2) sustained on grass and new generation turf by male and female footballers."
- Methods: The National Collegiate Athletic Association Injury Surveillance System was used for a two-season (August to December) prospective study of American college and university football teams (2005 season: men 52 teams, women 64 teams; 2006 season: men 54 teams, women 72 teams).
- Conclusion of both Part 1 and Part 2: There were no major differences in the incidence, severity, nature or cause of match injuries or training injuries sustained on new generation artificial turf and grass by either male or female players.

Risk of Injury in Elite Football Played on Artificial Turf Versus Natural Grass: A prospective two-cohort study

J. Ekstrand, T. Timpka, M. Hagglund
British Journal of Sports Medicine 2006; 40:975-980

- Objective: "To compare injury risk in elite football [soccer] played on artificial turf compared with natural grass."
- Conclusion: "No evidence of a greater risk of injury was found when football was played on artificial turf compared with natural grass. The higher incidence of ankle sprain on artificial turf warrants further attentior although this result should be interpreted with caution as the number of ankle sprains was low."

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Environmental & Health Risk of Synthetic Turf with Crumb Rubber Infill »

Comment on CPSC Report #20150608-22F81-2147431268
Assessment of the risk of cancer posed by rubber mulch used in playgrounds

Laura C. Green, Ph.D., D.A.B.T., June 29, 2015

- This letter-report from noted toxicologist, Laura C. Green, Ph.D., D.A.B.T., details the evidence that leads her to conclude that rubber mulch for playgrounds and crumb rubber infill for synthetic turf sports fields "...is neither known nor reasonably expected to cause cancer, and is otherwise safe for use...." Significantly, she further states, "More generally, no type of cancer in adolescents is known to be caused by overexposure to chemicals."

Tabor Academy – Synthetic Turf Athletic Field Evaluation

CDM Smith, March 13, 2014

- The objective of this study was to evaluate the potential water quality impacts of the synthetic turf field at Tabor Academy in Marion, MA.
- Conclusion: "...stormwater runoff from the athletic field is not a source of pollutants/contaminants that woul pose a threat to the harbor."

Artificial turf football fields: environmental and mutagenicity assessment

Schilirò, T1, et al., Arch Environ Contam Toxicol, 2013

- The aim of the present study was to develop an environmental analysis drawing a comparison between artificial turf football fields and urban areas relative to concentrations of particles (PM10 and PM2.5) and related polycyclic aromatic hydrocarbons (PAHs), aromatic hydrocarbons (BTXs), and mutagenicity of organi extracts from PM10 and PM2.5.
- Both organic extract mutagenicity values were comparable with the organic extract mutagenicity reported ir the literature for urban sites.
- On the basis of environmental monitoring, artificial turf football fields present no more exposure risks than the rest of the city.

Bioaccessibility and Risk of Exposure to Metals and SVOCs in Artificial Turf Field Fill Materials and Fibers

Environmental and Occupational Health Sciences Institute, Robert Wood Johnson Medical School, 170 Frelinghuysen Roac Piscataway, NJ, 2013

- "The SVOCs identified based on library matches of their mass spectra were not present in toxicological databases evaluated and many are ubiquitous part of consumer products. Similarly, the metal concentrations measured in field samples indicate that the risk would be de minimus among all populations expected to use artificial turf fields."

Review of the Human Health & Ecological Safety of Exposure to Recycled Tire Rubber found at Playgrounds and Synthetic Turf Fields

Prepared for Rubber Manufacturers Association by Cardno ChemRisk, Inc. (An independent global scientific consulting firm August 1, 2013

- A report by an independent environmental firm on the human health and ecological risks from ground rubber in playgrounds and sports fields, and based on a thorough review of studies from advocates and opponents tc the use of recycled tire materials.

Artificial turf football fields: environmental and mutagenicity assessment

Department of Public Health and Microbiology, University of Torino, Italy, 2012

Crumb Infill and Turf Characterization for Trace Elements and Organic Materials

Dr. Paul J. Lioy and Dr. Clifford Weisel, Environmental and Occupational Health Sciences Institute, Robert Wood Johnson Medical School, October 31, 2011, Submitted to NJDEP

An Evaluation of the Health and Environmental Impacts Associated with Synthetic Tur Playing Fields University of Connecticut Health Center

Connecticut Agricultural Experiment Station, Department of Public Health, Connecticut Department of Environmental Protection, July 2010

- The headline from the July 30, 2010 News Release from the Connecticut Department of Public Health announced, "Result of State Artificial Turf Fields Study: No Elevated Health Risk." Comprising separate reports from the four state agencies listed above, the Final Report presents the results of an extensive study into the health and environmental risks associated with outdoor and indoor synthetic turf fields containing crumb rubber infill. "This study presents good news regarding the safety of outdoor artificial turf fields," stated Department of Public Health Commissioner Dr. J. Robert Galvin.
- The above link is to the Overall Executive Summary, which includes links to the News Release, the four separate reports from the state agencies, and the report by the Peer Review Committee from The Connecticut Academy of Science and Engineering (see below).

Artificial Turf Field Investigation in Connecticut Final Report

Nancy Simcox, Anne Bracker, John Meyer, Section of Occupational and Environmental Medicine, University of Connecticut Heath Center, July 2010

DEP Artificial Turf Stormwater Study

University of Connecticut Health Center, The Connecticut Agricultural Experiment Station, the Department of Public Health and DEP, July 2010

Human Health Risk Assessment of Artificial Turf Fields Based upon Results from Five Fields in Connecticut

Connecticut Department of Public Health, Program in Environmental and Occupational Health Assessment, July 2010

Peer Review of an Evaluation of the Health and Environmental Impacts Associated with Synthetic Turf Playing Fields

Connecticut Academy of Science and Engineering, June 2010

2009 Study of Crumb Rubber Derived from Recycled Tires Final Report

Xiaolin Li, William Berger, Craig Musante, MaryJane Incorvia Mattina, Connecticut Agricultural Experiment Station, Department of Analytical Chemistry, May 2010

Hydroxypyrene in urine of football players after playing on artificial sports field with tire crumb infill

Joost G. M. van Rooij Æ, Frans J. Jongeneelen, International Archives of Occupational and Environmental Health, (2010) 83:105–110

- This study provides evidence that uptake of PAH of football players active on artificial grass fields with rubber crumb infill is minimal. If there is any exposure, then the uptake is very limited and within the range of uptake of PAH from environmental sources and/or diet.

Review of the Impacts of Crumb Rubber in Artificial Turf Applications

Simon, Rachel, University of California, Berkeley, Laboratory for Manufacturing and Sustainability, February 2010
Prepared for: The Corporation for Manufacturing Excellence (Manex)

- "The research conducted by Manex and Berkeley is among the most comprehensive reports to date, reviewing and assessing existing studies from the past 12 years, as well as containing independent analysis. The conclusions of this study validate key findings from other recent studies, demonstrating the materials are both cost-effective and safe."
- Extensive research has pointed to the conclusion that these fields result in little, if any, exposure to toxic substances. A review of existing literature points to the relative safety of crumb rubber fill playground and athletic field surfaces. Generally, these surfaces, though containing numerous elements potentially toxic to humans, do not provide the opportunity in ordinary circumstances for exposure at levels that are actually dangerous. Numerous studies have been carried out on this material and have addressed numerous different aspects of the issue. For the most part, the studies have vindicated defenders of crumb rubber, identifying it as safe, cost-effective, and responsible use for tire rubber.
  Recent issues that have surfaced relate to Carbon Black and Lead, however, for the vast majority of applications, serious physical harm has not occurred from these particulates.
- See April 5, 2010 Manex/UC Berkeley Press Release, Manex and UC Berkeley Issue Study on Recycled Rubber in Artificial Turf Applications

Safety Study of Artificial Turf Containing Crumb Rubber Infill Made from Recycled Tires: Measurements of Chemicals and Particulates in the Air, Bacteria in the Turf, and Skin Abrasions Caused by Contact with the Surface

Office of Environmental Health and Hazard Assessment, Department of Resources Recycling and Recovery, Editor. 2010, State of California

- PM2.5 and associated elements (including lead and other heavy metals) were either below the level of detection or at similar concentrations above artificial turf athletic fields and upwind of the fields. No public health concern was identified.

A Scoping-Level Field Monitoring Study of Synthetic Turf Fields and Playgrounds

National Exposure Research Laboratory Office of Research and Development U.S. Environmental Protection Agency, 2009

- This study and statements of safety by the U.S. EPA of synthetic turf fields and playgrounds containing crumt rubber from recycled tires complements the study and statement of safety by the CPSC in 2008 (see below). In its Press Release, the EPA summarized its findings, including the following:
  - The levels of particulate matter, metals, and volatile organic compound concentrations in the air samples above the synthetic turf were similar to background levels;
  - All air concentrations of particulate matter and lead were well below levels of concern;
  - Zinc, which is a known additive in tires…was found to be below levels of concern.
- See December 10, 2009 EPA Press Release, Limited EPA Study Finds Low Level of Concern in Samples of Recycled Tires from Ballfield and Playground Surfaces

Air Quality Survey of Synthetic Turf Fields Containing Crumb Rubber Infill

New York City Department of Health and Mental Hygiene, 2009

An Assessment of Chemical Leaching, Releases to Air and Temperature at Crumb-Rubber Infilled Synthetic Turf Fields

Lim, L. and R. Walker, New York State Department of Environmental Conservation and Department of Health, Editor, 2005

- Initial findings suggested that there was a low likelihood of risk to the environment or public health via drinking water from ground or surface water contamination.
- Further, the concentrations of VOCs and particulate matter detected above the surface of the fields did not exceed background levels, and thus do not suggest an increased risk from the installation of these fields.

Chemicals in Outdoor Artificial Turf: A health risk for users?

Beausoleil, Monique et. al, Public Health Branch, Montreal Health and Social Services Agency, June 2009

Zinc in Drainage Water Under Artificial Turf Fields with SBR

Hofstra, U., INTRON, March 2009

- On the basis of the new observations, we conclude that, after 7 years of use, zinc does not penetrate the underlays. This is consistent with the laboratory tests, in which it was calculated that zinc leaching will not

occur until a period of 230 to 1800 years has elapsed2. It can also be concluded that the concentrations of zinc in the drainage water are not significantly higher than the concentrations in the rainwater.
- After 7 years, there is no evidence that the use of rubber infill poses a risk in terms of the leaching of zinc.

A Review of the Potential Health and Safety Risks from Synthetic Turf Fields Containing Crumb Rubber Infill

Elizabeth Denly, Katarina Rutkowski, Karen M. Vetrano, Ph.D., TRC, Prepared for NYC Department of Health and Mental Hygiene, May 2008

- To date, eleven human health risk assessments were identified that evaluated exposure to the constituents in crumb rubber. Although each risk assessment was conducted using distinct assumptions and evaluated different concentrations of COPCs (chemicals of potential concern) in crumb rubber, all had a similar conclusion: exposure to COPCs from the crumb rubber may occur, however, the degree of exposure is likely to be too small through ingestion, dermal or inhalation to increase the risk for any health effect. The risk assessments have been conducted primarily by state agencies, consultants, and industry groups.

CPSC Staff Finds Synthetic Turf Fields OK to Install, OK to Play On

U.S. Consumer Product Safety Commission, NEWS from CPSC, July 30, 2008

- The CPSC staff conducted tests of synthetic turf products for analysis of total lead content and accessible lead. In the above News Release it concludes that, "young children are not at risk from exposure to lead in these fields."
- For a summary of the analytical methods used and the test results, see CPSC Staff Analysis and Assessment c Synthetic Turf "Grass Blades".

Evaluation of Potential Environmental Risks Associated with Installing Synthetic Turf Fields on Bainbridge Island

D. Michael Johns, Ph.D., Windward Environmental LLC, Seattle, WA, February 2008

- Review of available scientific literature and publications in order to provide an assessment about potential risks to the environment from zinc and chemicals contained in crumb rubber infill. "...water that percolates through turf fields with tire crumb is not toxic..."

Evaluation of Playing Surface Characteristics of Various In-Filled Systems

McNitt, A.S., 2008 April 9, 2008

- Total microbial numbers were lower in synthetic turf systems when compared to natural grass fields. Staphylococcus aureus was not found on any of the playing surfaces.

Evaluation of the Environmental Effects of Synthetic Turf Athletic Fields

Bristol, S.G. and V.C. McDermott, Milone & MacBroom, Inc., December 2008

- Heat: On hot sunny days, surface temp of the fibers was 40-50 degrees hotter than ambient temp; air temp a 2' above surface or under cloud cover was near ambient. Crumb rubber was only a few degrees hotter than ambient. Watering the field had a short-term effect.
- Off-gassing: EHHI identified certain compounds of concern in its very limited 2007 laboratory study of the chemicals contained in crumb rubber – benzothiazole, volatile nitrosamines, and 4-(tert-octyl) Phenol. MMI tested for these compounds in the air above the synthetic turf fields with crumb rubber infill at several locations. A "very low concentration" of benzothiazole was found at 1 of 2 fields -- the other compounds were not detected.
- Leaching: Testing done over one year period. Test for zinc, lead, selenium, and cadmium, and compared to lowest aquatic life criterion for each element. Only zinc detected, and then well below water quality standarc

Fact Sheet: Crumb-Rubber Infilled Synthetic Turf Athletic Fields

New York City Department of Health, August 2008

- Our review of the available information on crumb rubber and crumb rubber infilled turf fields indicates that ingestion, dermal or inhalation exposures to chemicals in or released from crumb rubber do not pose a significant public health concern.

Follow-up Study of the Environmental Aspects of Rubber Infill

Hofstra, U., INTRON, 2008

Initial Evaluation of Potential Human Health Risks Associated with Playing on Synthetic Turf Fields on Bainbridge Island

D. Michael Johns, Ph.D., Windward Environmental LLC, Seattle, WA, January 2008

- Review of available scientific literature and publications in order to provide an assessment about potential risks of human health to children and teenagers and the risks to the environment from precipitation runoff.

Hazardous Chemicals in Synthetic Turf Materials and Their Bioaccessibility in Digestive Fluids

Zhang JJ, Han IK, Zhang L, Crain W. et. al, 2008

Rubber Crumb Health Risk Evaluation

Lamie, P. Memorandum to: Richard Reine, Director Concord Public Works, April 24. 2007 [cited 2008 4/28]

- There is little exposure to and thus little risk from PAHs or other chemicals associated with ground rubber used in artificial turf fields to the human population.

Synthetic Playfields Task Force Findings and Department Recommendations

San Francisco Recreation and Park Department, 2008

- SFE recognizes that human health risks are minimal from exposure to the crumb rubber infill used with synthetic turf products, according to the OEHHA study.

Environmental and health assessment of the use of elastomer granulates (virgin and from used tyres) as infilll in third-generation artificial turf

Dr. Robert Moretto, ADEME / ALIAPUR / FIELDTURF TARKETT, 2007

- According to current research, after a year's experimentation, the results on the 42 physicochemical parameters identified and on the ecotoxocological tests show that water passing through artificial turf using as filling either virgin TPE or EPDM or granulates resulting from the recycling of PUNR are not likely to affect water resources in the short and medium term.
- In conclusion to its study, the INERIS stipulates that the health risks associated with the inhalation of VOC and aldehydes emitted by artificial surfaces on pitches in outdoor situations present no actual cause for concern as regards human health.
- Worst case indoor VOC and aldehyde concentrations do not pose a health concern for adult or child athletes

Environmental and Health Risks of Rubber Infill: Rubber crumb from car tyres as infill on artificial turf

Hofstra, U., INTRON, January 2007

- Based on the available literature on exposure to rubber crumb by swallowing, inhalation and skin contact and our experimental investigations on skin contact we conclude, that there is not a significant health risk due to the presence of rubber infill for football players an artificial turf pitch with rubber infill from used car tyres.

Evaluation of Health Effects of Recycled Waste Tires in Playground and Track Products

California Integrated Waste Management Board, 2007, Integrated Waste Management Board: Sacramento, CA

- Using the highest published levels of chemicals released by recycled tires, the likelihood for noncancer health effects was calculated for a one-time ingestion of ten grams of tire shreds by a typical three-year-old child; only exposure to zinc exceeded its health-based screening value (i.e. promulgated by a regulatory agency such as OEHHA or U.S. EPA). Overall, we consider it unlikely that a one-time ingestion of tire shreds would produce adverse health effects. Seven of the chemicals leaching from tire shreds in published studies were carcinogens, yielding a 1.2×10^{-7} (1.2 in ten million) increased cancer risk for the one-time ingestion described above. This risk is well below the *di minimis* level of 1×10^{-6} (one in one million), generally considered an acceptable cancer risk due to its small magnitude compared to the overall cancer rate (OEHHA, 2006).

Evaluation of health risks caused by skin contact with rubber granules used in synthetic turf pitches

Dr. Christa Hametner, Vienna, Dr. Hans Theodor Grunder, Berlin, 2007

- No significant health risks by either direct contact to rubber granules or by contact to rubber dust - with the exception of the risk of allergic reactions in indoor applications.

Leaching of zinc from rubber infill on artificial turf (football pitches)

Laboratory for Ecological Risk Assessment, 2007

- Human health risks posed by leaching of zinc are negligible as zinc concentrations in the water do not exceed drinking water standards. The risks of zinc to public health are of no concern: the human toxicity of zinc is low and WHO drinking water criteria are not exceeded.

Nitrosamines released from rubber crumb

van Bruggen, M., E.M. van Putten, and P.C.J.M. Janssen, 2007, RIVM: Bilthoven, the Netherlands

- Small quantities of nitrosamines emitted but not detectable in air; nitrosamine related health effects not likely.

Preliminary Assessment of the Toxicity from Exposure to Crumb Rubber: its use in Playgrounds and Artificial Turf Playing Fields

Thomas Ledoux, Ph.D., New Jersey Department of Environmental Protection, June 2007

- With the possible exception of allergic reactions among individuals sensitized to latex, rubber and related products, there was "no obvious toxicological concern" raised that crumb rubber in its intended outdoor use on playgrounds and playing fields would cause adverse health effects in the normal population.

Re: Ambient Air Sampling for PAH's, Schreiber High School Football Field (101 Campus Dr., Port Washington, NY 11050; Sampling Date: October 17, 2007)

Broderick, J.C., E. Vonderhorst, Editor, J.C. Broderick & Associates, Inc.: Port Washington, NY., 2007

Artificial turf pitches -- An assessment of the health risks for football players

Norwegian Institute of Public Health and the Radium Hospital, 2006, Oslo. p. 1-34.

- Recycled rubber granulate contains many chemical substances which are potentially harmful to health. The concentrations of these substances are however extremely low, they are only leached from the rubber granulate in very small quantities and they are only present in low concentrations in the hall air.
- It has been concluded that exposure to benzene and PAHs in the quantities in which they have been measure in the halls will not cause any increased risk of cancer using the halls.
- Chemical substances are released in very low quantities; based on worst case assumptions, use of artificial turf halls does not pose elevated risk; more information needed on natural rubber allergens.

An Open Letter concerning the potential cancer risk from certain granulate infills from artificial turf

FIFA, Prof. Dr. Jiri Dvorak, July 2006

- "The majority of the studies have been on higher surface area particles and have concluded they are currently acceptable. Therefore the larger granules used in artificial turf will have even less potential for emissions. For example a study undertaken by the Danish Ministry of the Environment concluded that the health risk on children's playgrounds that contained both worn tyres and granulate rubber was insignificant. The available body of research does not substantiate the assumption that cancer resulting from exposure to SBR granulate infills in artificial turf could potentially occur."

Synthetic Turf from a Chemical Perspective - A status report

The Swedish Chemicals Inspectorate (Kemi), KEMIKALIENIMSPEKTIONEN Sundbyberg. p. 1-31, 2006

Measurement of non-exhaust particulate matter

Luhana, L., et al., 2004, Deliverable 8 of European Commission DG TrEn 5th Framework PARTICULATES Project

- In comparison to the indoor fields, 7.5 percent of PM10 at an urban Switzerland curb side sampling location was attributed to tire wear particles. The fraction of PM10 attributed to tire wear particles was 2 percent at an urban background site. The levels of PM10 attributable to ground rubber measured at Norwegian fields appear to be similar in magnitude levels attributed in ambient air near roadways or tunnels. Typical ambient tire wear particle concentrations of PM10 or total suspended particulate are 2-5 µg/m3 for roadways and 10 20 µg/m3 for tunnels. Research to date has shown a highly variable distribution between fine (< 2.5 µm) and coarse (>7 µm) in airborne roadside tire wear particles.

Environmental Risk Assessment of Artificial Turf Systems

Kallqvist, T., Norwegian Institute for Water Research: Oslo. p. 1-19, 2005

Potential health and environmental effects linked to artificial turf systems – final report

Plesser, Thale S.W., Lund, J. Ole, Norwegian Building Research Institute, September 2004

- Rubber granules contain lead, cadmium, copper, mercury, zinc, PAHs, phthalates, 4- toctylphenol and isononylphenol.
- Concentration of lead, cadmium, copper and mercury in the rubber granules is below the Norwegian Pollutio Control Authority's normative values for most sensitive land use and probably does not constitute an unacceptable environmental risk in the short or the long term.
- Concentrations of zinc and PAH in the recycled rubber granules exceed the Norwegian Pollution Control Authority's normative values for most sensitive land use. The concentrations of dibutylphthalate (DBP) and diisononylphthalate (DINP) exceed the PNEC values for terrestrial life.
- Concentration of isononylphenol is above the limits specified for cultivated land in the Canadian Environmental Quality Guidelines.
- Leachate from the recycled granulates contain zinc, polycyclic aromatic hydrocarbons (PAH), phthalates and phenols. The concentration of zinc indicates that the leachate water is placed in the Norwegian Pollution Control Authority's Environmental Quality Class V (very strongly polluted water), but is lower than the permissible zinc concentration in Canadian drinking water. The concentration of anthracene, fluoranthene, pyrene and nonylphenols exceed the limits for freshwater specified in the Canadian Environmental Quality Guidelines.
- The recycled rubber granulates give off a significant number of alkylated benzenes in gaseous form. Trichloromethane (sample 1) and cis-1,2-dichlorethene (sample 5) were also found.

Toxicological Evaluation for the Hazard Assessment of Tire Crumb for Use in Public Playgrounds

Birkholz, D.A., K.L. Belton, and T.L. Guidotti, J. Air & Waste Management Association, July 2003

- "Genotoxicity testing of tire crumb samples following solvent extraction concluded that no DNA or chromosome-damaging chemicals were present. This suggests that ingestion of small amounts of tire crumb by small children will not result in an unacceptable hazard of contracting cancer."
- We conclude that the use of tire crumb in playgrounds results in minimal hazard to children and the receiving environment.
- Extracts were not genotoxic and exposure potential in children deemed minimal; tire rubber at playgrounds does not pose a health hazard to children.
- An exposure assessment performed to address the potential health risks to children playing in facilities wher tire crumb is used as ground cover concluded that there was little potential for an exposure sufficient to caus ad- verse health effects in children.

Five Year Study of the Water Quality Effects of Tire Shreds Placed Above the Water Table

Humphrey, D.N. and E.K. Lynn, Department of Civil and Environmental Engineering, University of Maine, March 2001

- Tire shreds have a negligible impact on groundwater quality at neutral pH.

Emission Characteristics of VOCs from Athletic Tracks

Chang, F.H., et al., J Hazard Mater, 1999. 70(1-2): p. 1-20

- From 67 to 160 °F, the vapor pressure of benzothiazole increases by a factor of almost 40. However, based o a study of a synthetic rubber athletic track, total VOC emissions are estimated to increase by a factor of only over the same range. No exposure estimates or risk calculations were determined based on results from this study. However, total VOC concentration at breathing height above the track was 0.39 µg/m3.

Environmental Impacts of Recycled Rubber in Light-Fill Applications

Liu, Helen S., et. al., Department of Plastics Engineering, University of Massachusetts Lowell, August 1998

- Recycled rubber derived from scrap tires is a safe recyclable material. Based on the evidence presented, the overwhelming conclusion is that it would be reasonable to recommend use of recycled scrap tires in civil engineering applications.

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Heat »

National Athletic Trainers' Association Offers Tips for Exercising Safely in the Heat

National Athletic Trainers' Association, July 8, 2010

- News Release highlighting key recommendations made in NATA's Official Position Statement below.

National Athletic Trainers' Association Position Statement: Exertional Heat Illnesses

Helen M. Binkley; Joseph Beckett†; Douglas J. Casa; Douglas M. Kleiner; Paul E. Plummer
Journal of Athletic Training, Volume 37, Number 3, September 2002, pp. 329–34

- Recommendations for the prevention, recognition, and treatment of exertional heat illnesses.

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Staph & MRSA »

Chemicals and Particulates in the Air Above the New Generation of Artificial Turf Playing Fields, and Artificial Turf as a Risk Factor for Infection by Methicillin-Resistant Staphylococcus Aureus (MRSA)

Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, July 2009

- There is a negligible human health risk from inhaling the air above synthetic turf, and, though data gaps exist, it is "unlikely that the new generation of artificial turf is itself a source of MRSA...." (Significantly the OEHHA did not review the January 2009 results of the study into the lifespan of staph on grass and synthetic turf sponsored by the STC and the Pennsylvania Turfgrass Council - see below.)
- The OEHHA summary of the results is available here: **http://www.calrecycle.ca.gov/tires/products/bizassist/health/turfstudy/litreview.htm**
- The full report includes an important Addendum that references reports by the New York State Department of Environmental Conservation and Department of Health (May 2009) and the New York City Department o Health and Mental Hygiene (March 2009) - see below.

Survival of Staphylococcus aureus on Synthetic Turf

Andy McNitt, Ph.D., Associate Professor of Soil Science, Penn State University, December 2008.
A research project funded by the Synthetic Turf Council and the Pennsylvania Turfgrass Council

- A study to examine the survival of S. aureus on infilled synthetic turf systems and natural turfgrass under different environmental conditions and to evaluate the effectiveness of various control agents applied to the synthetic turf.
- S. aureus survived for as long on natural turfgrass as it did on synthetic turf systems in both indoor and outdoor settings. S. aureus lived longest indoors, but can be effectively treated with commercially available antimicrobial treatments as well as detergents. Outdoors S. aureus has a very low rate of survival, particularl when exposed to UV light and higher temperatures.

Environmental Management of Staph and MRSA in Community Settings

Centers for Disease Control and Prevention, July 2008

A Survey of Microbial Populations in Infilled Synthetic Turf Fields

Andy McNitt, Ph.D., Associate of Professor of Soil Science, Penn State University, and Dianne Petrunak, M.S., and Thomas Serensits, M.S., June 2007

- A survey to determine the microbial population of several crumb rubber infilled synthetic turf systems and natural turfgrass fields.

Official Statement on Community-Acquired MRSA Infections (CA-MRSA)

National Athletic Trainers' Association, March 1, 2005

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Newsroom more

2/17/2016
Announcement from EPA and other key news items

2/29/2016
In Memoriam: Ron Van Gelderen

2/18/2016
UPDATE: STC Donates New Playing Field to Stuart Hobson Middle School

Industry Calendar more

3/7/2016 - 3/19/2016
Annual (New York) State Athletic Director's Conference

4/9/2016 - 4/11/2016
National School Boards Association (NSBA) Annual Conference

6/8/2016
European Synthetic Turf Organisation (ESTO) Congress

New Members

Service Thread

Manufacturer of sewing thread used for field installations

Precision Turf LLC

Hellas

Online Surveys

STC Membership Survey

New Member Survey

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Overview of the Proposed Genotoxicity Study of Recycled Rubber

Michael K. Peterson, MEM, DABT

March 22, 2016

GRADIENT

Protocol/Method Considerations

- Use established OECD methods (2)
- Use validated cell lines (2)
- Account for bioaccessibility (3 simulated biofluids)
  - Work w/ CalOEHHA so studies are complimentary
- Account for multiple conditions
  - Virgin RR
  - Field samples (~5 year old fields)
  - Natural soil as comparative sample
  - Both positive and negative controls
  - Include S9 to account for bioactivation

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Study Outline

Phase 1: Evaluation of virgin crumb rubber (CR) lots from independent manufacturers (M), 5 year field and soil samples

6 virgin CR and aged samples and 6 field soil sample

Assays are performed in triplicate

Virgin CR M A-F: 6 samples

CR 5 year aged samples A-F: 6 samples

Soil samples Fields A-B: 2 samples

14 samples X 3 biological fluid analysis for each= 42 samples
1) Ingestion–digestive fluid; 2) Dermal–sweat; 3) Inhalation–lung

42 samples +/- S9 liver homogenate = 84 samples
2 Assays: *In Vitro* Micronucleus and HPRT assay= 168 samples

Positive control: Benzo(a)pyrene; Negative control: Biological fluids alone
3 pos. and 3 neg control for each assay +/- S9= 24 samples +168= 192 samples for the study

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Other Examples of Test System Use

- MN/HPRT systems w/ TK6 and V79 cells

Dicholesteroyl diselenide: Cytotoxicity, genotoxicity and mutagenicity in the yeast *Saccharomyces cerevisiae* and in Chinese hamster lung fibroblasts

Genotoxicity testing of three monohaloacetic acids in TK6 cells using the cytokinesis-block micronucleus assay

DNA Lesion and *Hprt* Mutant Frequency in Rat Lymphocytes and V79 Chinese Hamster Lung Cells Exposed to Cadmium

High level glucose increases integrase in human lymphoblastoid cells

Mutagenicity of 2-amino-3-methylimidazo[4,5-*f*]quinoline in human lymphoblastoid cells

Mutagenesis vol. 26 no. 6 pp. 805–811, 2011
Advance Access Publication 29 July 2011
Does formaldehyde induce aneuploidy?

Characterization of *hprt* mutations following 1,2-epoxy-3-butene exposure of human TK6 cells

A combination of *in vitro* comet assay and micronucleus test using human lymphoblastoid TK6 cells

Integration of metabolic activation with a predictive toxicogenomics signature to classify genotoxic versus non-genotoxic chemicals in human TK6 cells

Impact of nanosilver on various DNA lesions and *HPRT* gene mutations – effects of charge and surface coating

4

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Next Steps

- Phase 1: In vitro study is underway
  - ~12 weeks
- Phase 2: Long-term animal study
  - Schedule TBD

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Questions?

Michael K. Peterson, MEM, DABT

March 22, 2016

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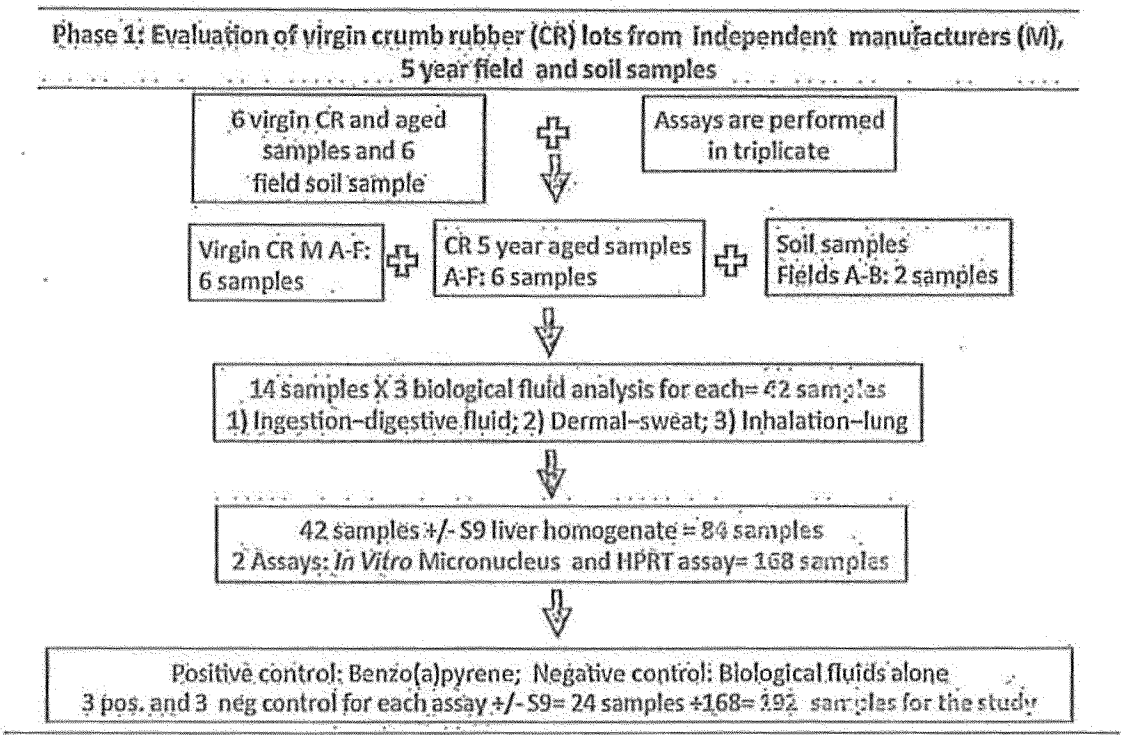
Evaluation of the Potential Genotoxic and Carcinogenic Effects of Recycled Rubber

Objective

- Phase 1: Assess the genotoxic and mutagenic potential of recycled rubber and field soil using *in vitro* assays.
- Phase 2: Evaluate the carcinogenic potential of recycled rubber in an long-term animal bioassay.

Phase 1 Overall Study Design

- Fourteen field samples will be extracted in solutions mimicking biological fluids that represent key routes of exposure.
- Field sample extracts, in addition to positive and negative controls, will be tested for genotoxic potential using two international guideline *in vitro* genotoxicity assays.
- Assays will be run in triplicate in the presence and absence of metabolic activation.
- Proposed studies will be performed using a double-blind procedure.



Phase 1 Key Methods

- Samples
  - 6 Virgin recycled rubber
  - 6 Aged recycled rubber (5 years)
  - 2 Soil

- Biological Fluid Analysis
  - Digestive fluid (Ingestion route)
  - Sweat (Dermal route)
  - Lung (Inhalation route)
- Experimental Protocols
  - Genetic toxicity assays will be conducted according to Organization for Economic Co-operation and Development (OECD) test guidelines (TG).
    - Hypoxanthine phosphorybosyl transferase (HPRT) Assay (OECD TG 476, 7/28/2015)
      - The HPRT gene is on the X chromosome of mammalian cells, and it is used as a model gene to investigate whether chemicals can induce gene mutations in mammalian cell lines.
    - *In Vitro* Micronucleus assay (OECD TG 487, 9/26/2014)
      - A micronucleus (MN) test provides a comprehensive basis for investigating the chromosome damaging potential *in vitro* that can be transmitted to daughter cells.
  - Cell Models
    - V79 lung fibroblast cells, acceptable by OECD, will be used with lung fluid for HPRT and MN assays.
    - TK6 lymphoblastoid cells, acceptable by OECD, will be used with gastric and sweat fluids for HPRT and MN assays.
  - Controls
    - Benzo[a]pyrene (Positive control)
    - Biological fluids alone (Negative control)
  - Metabolic Activation
    - These studies are performed in the presence and absence of S9 liver homogenate to activate metabolism of the components of the chemical extracts by the cytochrome p450 system.

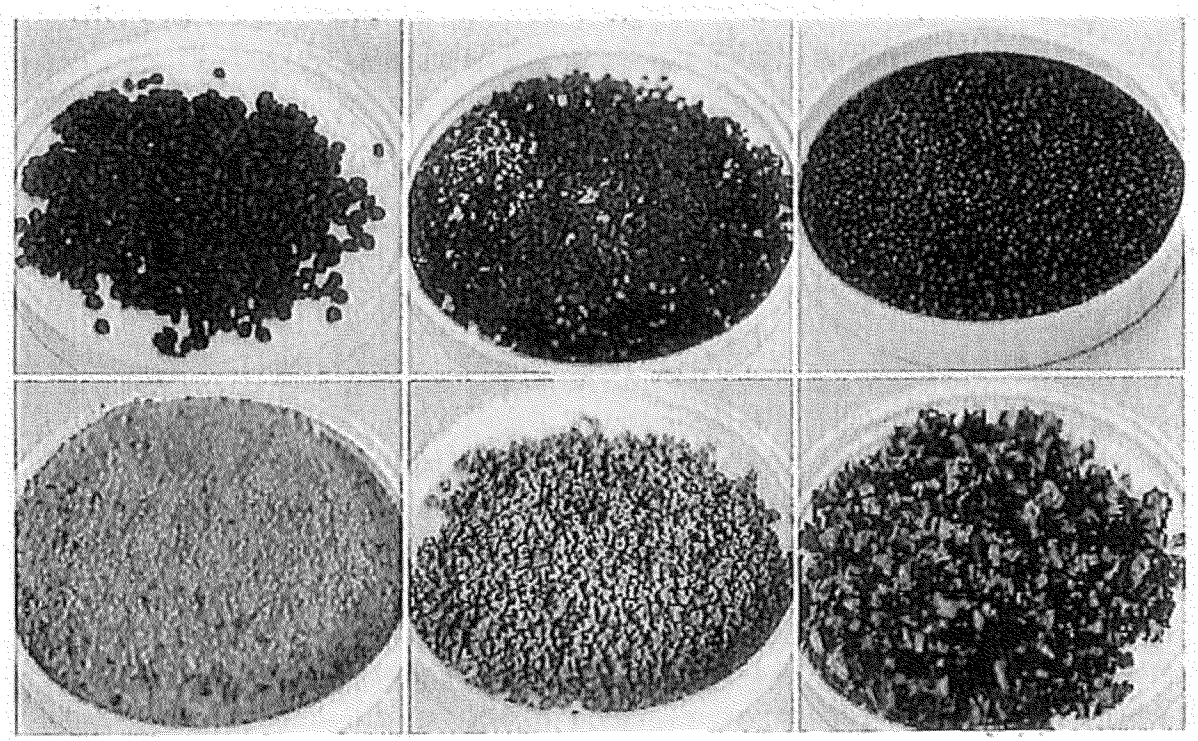
Future Work

- Phase 1: In progress; hopefully completed in 12 weeks with manuscript submittal anticipated
- Phase 2: Chronic animal bioassay; methods and schedule to be determined

www.SyntheticTurfCouncil.org

Synthetic Turf COUNCIL

Suggested Environmental Guidelines for Infill



Published August 2015

Synthetic Turf COUNCIL

Suggested Environmental Guidelines for Infill

Printed August 25, 2015

400 Galleria Parkway, Suite 1500

Atlanta, GA 30339

Suggested Environmental Guidelines for Infill

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Introduction

With billions of square feet of synthetic turf installed throughout the world, the Synthetic Turf Council (STC) is pleased that so many owners, players and children have enjoyed the appearance, performance, playability, water savings and longevity benefits these modern surfaces provide. Infill materials have played a key role in synthetic turf as they are often used in supporting one or more of the following objectives:

- Shock absorption
- Traction
- Foot stability
- Player safety
- Surface consistency
- Extending the synthetic turf's useful life
- Improve game performance

Due to these benefits, the use of infill materials in synthetic turf fields is widely accepted. Infill materials currently available include a variety of options, including crumb tire rubber, sand, elastomers, zeolite, organic materials, coated sand and coated rubber.

The STC has gathered considerable scientific information, specifically on crumb rubber infill. Much of this research can be found on the STC website, www.syntheticturfcouncil.org. Although no research to date has found any elevated health risk of humans interacting with synthetic turf or infill, the STC continues to gather and support research performed by credible and independent sources.

The purpose of these suggested voluntary guidelines is to provide owners, buyers and interested stakeholders an additional resource to better understand the environmental and toxicological considerations when evaluating the use of infill materials.

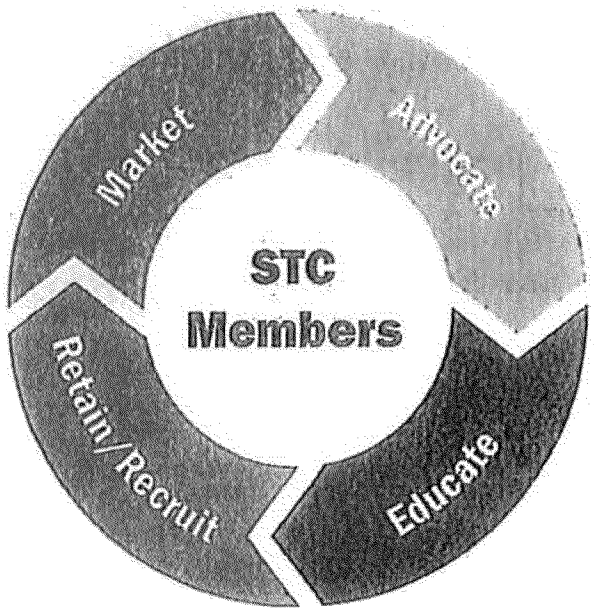
Objectives

The objectives of these voluntary guidelines are to:

- Reflect the core of the STC objectives and Mission Statement:

  Committed to community wellness and environmental responsibility through the use of synthetic turf, the Synthetic Turf Council is the industry's voice for promoting the highest ethical and professional standards, education, legislative and community advocacy.

- Suggest an objective guideline for limits on heavy metals based upon proven scientific toxicology test methods.
- Provide information and educational tools for parents, players, owners, and operators of synthetic turf fields.
- Continue to advocate social responsibility, respond to market questions, and provide useful tools and data to STC members.



Suggested Environmental Guidelines for Infill

The STC suggests that any toxicological test and analysis of infill for synthetic turf fields be performed according to **European Standard EN 71-3 – Safety of Toys Part 3: Migration of certain elements.**

The EN 71-3 protocol specifies maximum migration limits for three categories of (toy) materials. The limits for the migration of certain elements are expressed in milligrams per kilogram (parts per million) of the tested material and should be detailed in the testing report. The purpose of the limits of the European protocol is to minimize children's exposure to certain potentially toxic elements. EN 71-3 concerns all toys and materials that might be ingested. While the STC does not consider synthetic turf infill as a toy or children's product, pieces of infill can be ingested. The STC has identified Category III of EN 71-3 to be the closest definition to infill materials.

Under EN 71-3, soluble elements are extracted from materials using conditions which simulate the material remaining in contact with gastric juices for a period of time after swallowing. The concentrations of the soluble elements are determined quantitatively by two different methods:

1. Method for determining general elements: Aluminum, Antimony, Arsenic, Barium, Boron, Cadmium, Cobalt, Copper, Lead, Manganese, Mercury, Nickel, Selenium, Strontium, Tin and Zinc; and
2. Method for determining Chromium (III) and Chromium (VI).

The STC suggests that if performed, these tests should be performed by an ISO/IEC 17025 accredited laboratory, which assures testing in an independent and scientific manner. The test report should indicate:

- Name and details of the testing laboratory
- Description of the product tested
- Name of the product tested
- Manufacturer of the product tested
- Sample number or identification
- Date of the tests
- Table of substances tested including element, unit of measure, test method, results, compliance requirements and pass/fail indication

Table of Substances Tested

Element	Test method	STC Guideline per EN 71-3, Category III (in mg/kg MS)
Aluminum	NF EN ISO 11885	70,000
Antimony	NF EN ISO 11885	560
Arsenic	NF EN ISO 11885	47
Barium	NF EN ISO 11885	18,750
Boron	NF EN ISO 17294-1 et 2	15,000
Cadmium	NF EN ISO 11885	17
Cobalt	NF EN ISO 11885	130
Copper	NF EN ISO 11885	7,700
Lead	NF EN ISO 11885	160
Manganese	NF EN ISO 11885	15,000
Mercury	NF EN 13506	94
Nickel	NF EN ISO 11885	930
Selenium	NF EN ISO 11885	460
Strontium	NF EN ISO 17294-1 et 2	56,000
Tin	NF EN ISO 17294-1 et 2	180,000
Zinc	NF EN ISO 17294-1 et 2	46,000
Chromium III	NF EN ISO 11885	460
Chromium VI	NF T 90-043	0.2

Certificate of Compliance

If the testing is performed, a Certificate of Compliance to these guidelines may be issued by the infill supplier, including the following information:

- Identification of the product covered by the Certificate of Compliance
- Citation that the product complies with the STC's *Suggested Environmental Guidelines for Infill* and EN 71-3 Standard – Safety of Toys Part 3: Migration of certain elements
- Identification of the infill supplier
  - ⇒ Company name, full mailing address and telephone number
  - ⇒ Contact information for the individual maintaining records of test results that supports of the certification
  - ⇒ Manufacturing location of the infill product
- Validity dates of the certificate
  - ⇒ Initial testing should be performed in conjunction with the initial certification by the infill supplier
  - ⇒ Ongoing production should be tested at least once annually and tested again within the same year if a change in production materials or process occurs that could affect compliance with these STC suggested guidelines
- Identification of the date, laboratory name and place when the product was tested for compliance
- Signature of an authorized legal representative

Disclaimer

These voluntary Guidelines were prepared in good faith and are suggested as a limited informational tool only. The resources referenced herein are believed by the STC to be reliable; however, users of this document are strongly encouraged to consult their own professional advisors and conduct their own research concerning any matters herein. These Guidelines are not standards and are not to be used as the basis for warranty or other claims. The Guidelines are also not, and are not intended to be considered as, safety standards and do not imply that an injury or illness is less likely to occur if the Guidelines are followed or that an injury or illness is more likely to occur if the Guidelines are not followed. The suggestions contained in and the resources referenced are not exhaustive and there may be other resources and information concerning these issues that should be considered. This document contains information concerning current infill products used with synthetic turf only and does not address any other components of the synthetic turf system. The use of these Guidelines is voluntary, unless otherwise agreed.

About the Synthetic Turf Council

Based in Atlanta, the Synthetic Turf Council was founded in 2003 to promote the industry and to assist buyers and end users with the selection, use and maintenance of synthetic turf systems in sports field, golf, municipal parks, airports, landscape and residential applications. The organization is also a resource for current, credible, and independent research on the safety and environmental impact of synthetic turf. Membership includes builders, landscape architects, testing labs, maintenance providers, manufacturers, suppliers, installation contractors, infill material suppliers and other specialty service companies. For more information, visit the STC's Online Buyers' Guide and Member Directory at www.syntheticturfcouncil.org.

Synthetic Turf™
COUNCIL

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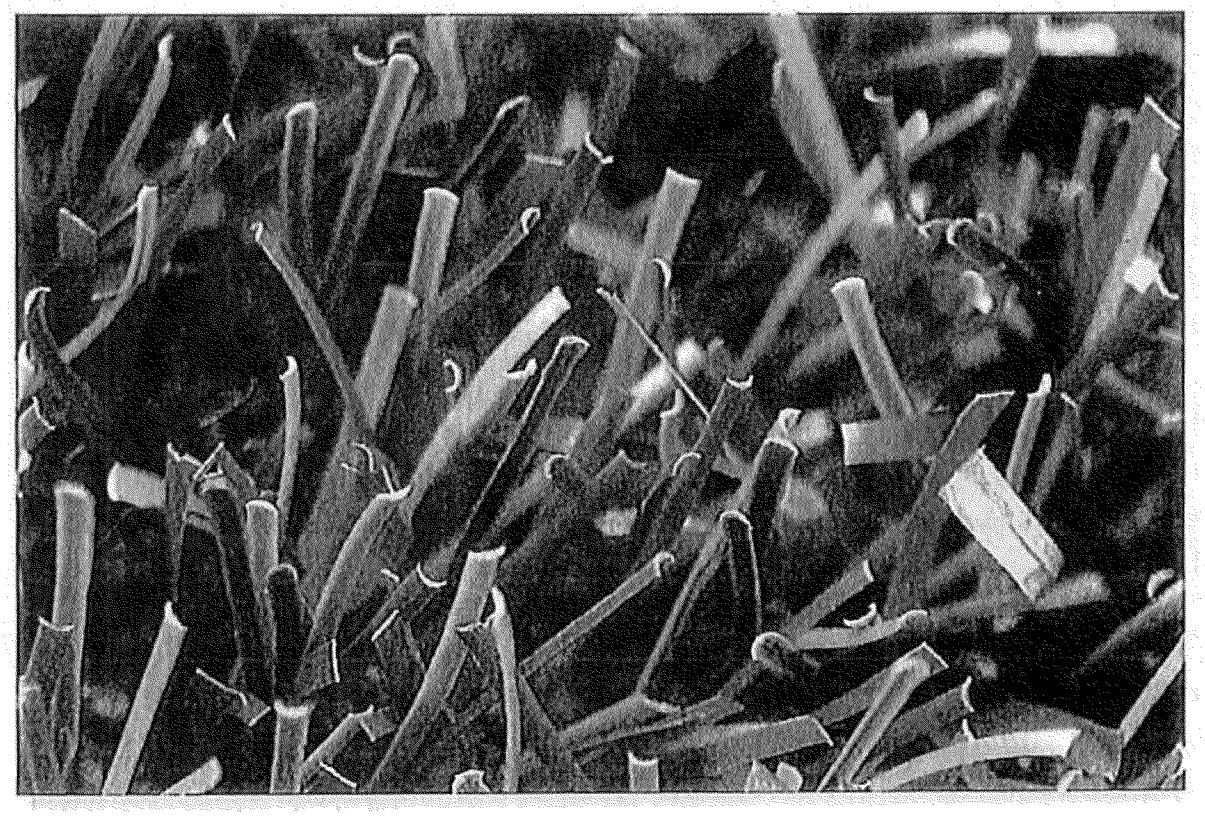
Guidelines for Crumb Rubber Infill Used in Synthetic Turf Fields



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Guidelines for Crumb Rubber Infill Used in Synthetic Turf Fields

Printed October 2010

Revised October 23, 2014

400 Galleria Parkway, Suite 1500

Atlanta, GA 30339

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Table of Contents

Introduction

Purpose

To provide producers, customers and the public with an understanding of what CRI is and how the industry manages its safety, purity and quality.

Objectives

- Clear standards on origin and composition of CRI
- Clear standards on cleanliness and purity of CRI
- Guidance on testing, sampling and packaging of CRI

General Characteristics of Crumb Rubber Infill (CRI)

Effective January 1, 2011:

The CRI used in artificial turf fields shall be derived from used whole vulcanized automobile, SUV, and truck tires (DOT tires for over the road). Buffings, bladders and tubes shall not be used as feedstock for CRI.

The CRI shall have a specific gravity range from 1.1 minimum to 1.2 maximum grams per cubic centimeter as determined by ASTM D 297 (including any modifications made by ASTM in the future).

The CRI shall have an ash content of between 5 and 15% as determined by ASTM D 297 (including any modifications made by ASTM in the future).

CRI made after Jan 1, 2011 shall not contain more than .01% liberated fiber (mathematically expressed as 0.0001) (no more than 0.2 lbs. per ton, which is 3.2 ounces of fiber per 2,000 lb. supersack which is approximately 25 lbs. of fiber per average field) tested per ASTM D 5603. The liberated fiber remaining in the CRI shall be free flowing and not agglomerated into clumps of fiber as received at the job site. CRI made before Jan 1, 2011 shall contain no more than 0.05% liberated fiber. All CRI sold after 12/31/11 must meet the 0.01% standard.

The CRI shall be dry and free flowing.

Sieve/gradation specification shall be agreed upon between customer and producer.

Processing Standards for CRI

- CRI shall be produced cryogenically, ambiently, or a combination.
- Scales used for bagging must be certified per local/state requirements.

Certification Compliance

Suppliers shall certify that the CRI is derived from only used, whole, vulcanized automobile, SUV, or truck tires and produced in compliance with North American tire manufacturing specifications.

Providers of CRI shall provide in writing that they maintain an ongoing Quality Control program meeting all the standards of the STC Guidelines for CRI Used in Synthetic Turf Fields and capable of meeting all the specifications described herein.

Shipment and/or Order Certification shall include at least the following information:

- Type and origin of raw material (certify that it comes from tires)
- Production facility
- Production method (cryo or ambient)
- Fiber content (%)
- CRI sieve/gradation analysis

Old Packaging (applicable before 12/31/2010)

Supersacks must meet the following specifications:

- Rated 2,200 (minimum) working load
- Rated 5:1 safety factor
- Minimum loop length of 8"
- UV treated with a 1,200 hour standard
- Minimum fabric weight of 5.5 ounce
- Side seams: at least 50% of the way down the bag
- At point of shipment bag should be clean and free of debris
- The supersack shall be secure and stable on the pallet
- Customers shall be billed for net weight of rubber shipped
- All supersacks must have traceability to date of production
- In the case of used/recycled supersacks:
- Certified as 1x only prior use and indoor use only
- Certified as cleaned of prior use materials

New Packaging (applicable on and after 1/1/2011)

New supersacks must be used and must meet the following specifications. All material (regardless of date of manufacture) must be in new supersacks:

- Rated 2,200 (minimum) working load
- Rated 5:1 safety factor
- Minimum loop length of 8"
- UV treated with a 1,200 hour standard
- Minimum fabric weight of 5.5 ounce
- Side seams: at least 50% of the way down the bag
- At point of shipment bag should be clean and free of debris
- The supersack should be secure and stable on the pallet
- Customers should be billed for net weight of rubber shipped
- All supersacks should have traceability to date of production
- CRI producers may use used supersacks if a customer specifies them.

Packaging

Pallets will meet the following specifications:

- 2 way or 4 way
- No broken or cracked boards
- No missing boards
- Fasteners all level with surface, none missing
- Construction:
  - ⇒ Top: 1 x 4's (measuring ¾" thick x 3.5" wide); gaps < 3"
  - ⇒ Structural: 2 x 4's (measuring 1.5" x 3.5"), minimum of 3
  - ⇒ Bottom: 1 x 4's (measuring ¾" thick x 3.5" wide), minimum of 3

Field Quality Testing and Sampling

Equipment:

- Sampling stick
- Sample splitter
- Sample tray (width = 12", length = 12", Depth = 3")
- High precision scale (0.01 gram)
- Tweezers

Sampling:

- Randomly select 3 bags (super sacks) per load of infill material.
- Record the bag information such as bag number, lot number, date shipped, bill of lading number, etc.
- Place the sampling stick into the bag vertically 3 times in 3 different locations and collect 3 samples.
- Place the 3 samples into a plastic bag.
- Repeat above steps until at least 3000 grams of crumb rubber are obtained.
- Shake the collected sample well.

Field Quality Testing and Sampling *(continued)*

Measurements:

- Use the sample splitter to divide the crumb rubber sample evenly into 2 portions.
- Send 1 portion to the supplier with proper bag, lot, etc. identification as recorded above.
- Spread the second portion evenly on the sample tray and pick up all the free fabric with tweezers and place in the weighing tray of the scale.
- Weigh the collected fabric.
- Divide the weight of the fabric by the total weight of infill material in the tray and multiply the result by 100 to calculate percent fabric contamination.
- Repeat 3 times and average the result.
- Document the result with the proper bag, lot, etc. identification recorded above and report results to the supplier.

Standard Format MSDS

To create and maintain a uniform understanding of CRI in the marketplace, all CRI suppliers should use an MSDS (Material Safety Data Sheet) with essentially the same elements and components.

The following format is the recommended MSDS format based on research that suggests more specificity is not required. Any producer who has received other counsel is free to use a more detailed MSDS.

Please note that this recommended format is intended to be fully consistent with OSHA and Canadian requirements and eliminates much of the chemical terminology that has historically been included because initial MSDS were derived from those used in the tire manufacturing industry.

MATERIAL (CAS)	WT%	OSHA PEL	(ACGIHTLV)
Vulcanized Rubber Compound	Approx. 99%	N/A	N/A
Talc (Hydrous Magnesium Silicate)	Less than 4%	2.0 mg/m³	2.0 mg/m³
FLASH POINT: Ignition temperature of dust cloud 320 degrees Centigrade (608 F) approximately		FLAMMABLE LIMITS	N/A

HAZARDOUS INGREDIENTS PRODUCT IDENTIFICATION/CHEMICAL & PHYSICAL CHARACTERISTICS			
PRODUCT NAME	Crumb Rubber	**SOLUBILIY IN WATER**	Insoluble
APPEARANCE	Black granular powder	**ODOR**	Slight smell of
SPECIFIC GRAVITY	1.1—1.2 g/cm³	**MELTING POINT**	N/A
VAPOR PRESSURE	N/A	**VAPOR DENSITY**	N/A
EVAPORATION RATE	N/A	**BOILING POINT**	N/A

Standard Format MSDS *(continued)*

FIRE AND EXPLOSION HAZARD DATA	
LEL—.025 OZ/CU.FT. *	UEL: N/A
EXTINGUISHING MEDIA:	Water, foam, dry powder, encapsulating fire suppressant. (DO NOT USE HIGH PRESSURE WATER)
SPECIAL FIRE FIGHTING PROCEDURES:	Noxious gases may be formed under fire conditions. West NIOSH approved self contained apparatus.
UNUSUSAL FIRE AND EXPLOSION HAZARDS:	Dust may be explosive if mixed with air in critical proportions and in the presence of an ignition source. The hazard is similar to that of many organic solids.

* Estimates based on the NPFA Fire Protection Book

Standard Format MSDS *(continued)*

HAZARDOUS INGREDIENTS HEALTH HAZARD DATA	
STABLE: Yes	CONDITIONS TO AVOID: Conditions that will cause burning
INCOMPATIBILITY (Materials to avoid)	Avoid strong oxidizing agents
HAZARDOUS DECOMPOSITION OF BYPRODUCTS	Thermal decomposition may produce carbon monoxide, carbon dioxide, zinc oxide fumes/ dust, sulfur dioxide, liquid and gaseous hydrocarbons.
HAZARDOUS POLYMERIZATION : Will not occur	CONDITIONS TO AVOID: Do not store hot material in hoppers due to possibility of spontaneous combustion.
ROUTES OF ENTRY	Inhalation
HEALTH HAZARDS (Acute and Chronic)	This product can contain fine fibers that may cause itching. Otherwise, not known. This material is generally thought to be a nuisance dust.
CARCINOGICITY	Rubber is not listed as a carcinogen.
SIGNS AND SYMPTOMS OF EXPOSURE	Itching of skin, irritation of mucous membranes, sneezing and coughing, irritation of eyes.
MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE	Not known; however, could potentially aggravate allergies due to dust exposure/ inhalation.
EMERGENCY AND FIRST AID PROCEDURES	Normal washing of skin with soap and water. Ordinary means of personal hygiene are adequate.

Standard Format MSDS *(continued)*

PRECAUTIONS FOR SAFE HANDLING AND USE	
STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED	Sweep up or vacuum into disposal containers
WASTE DISPOSAL METHOD	Product not defined as hazardous waste. Dispose of in accordance with federal, state, and local regulation.
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE	Do not store near flame or ignition source. Do not store hot material in tubs or containers where spontaneous ignition could occur.
OTHER PRECAUTIONS	If material burns, an oily residue will result. This residue must be disposed of in accordance with federal, state and local regulations.
RESPIRATORY PROTECTION (Specify Type)	Use any dust and mist respirator noted for up to 10 mg/m^3.

CONTROL MEASURES	
VENTILATION: Yes	LOCAL EXHAUST: Yes, if dusty conditions occur.
SPECIAL: None	MECHANICAL (General): Dust collector and
PROTECTIVE GLOVES: Recommended	EYE PROTECTION: Use safety goggles to prevent dust entry.
OTHER PROTECTIVE CLOTHING OR EQUIPMENT	Enough fresh air should flow past the user to prevent exposure to airborne fibers and particles.
WORK/HYGENE PRACTICES	Good personal hygiene; frequent washing with soap and water of exposed areas; remove and clean solid clothing.

The information contained in this MSDS is consistent with the U.S. Department of Labor OSHA Form OMB 1218-0072. Consult OSHA Hazard Communication Standard 29 CFR 1910.1200 for additional information. To fully understand the use of any material, the user should avail themselves of reference material and expert consultation in the fields of fire prevention, ventilation and toxicology.

About the Synthetic Turf Council

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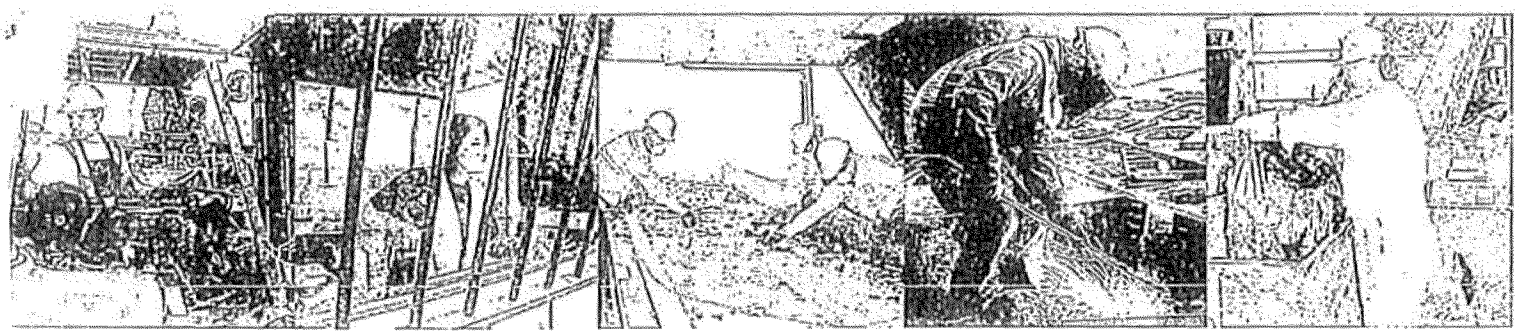
Economic Impact Study

U.S.- Based Scrap Recycling Industry

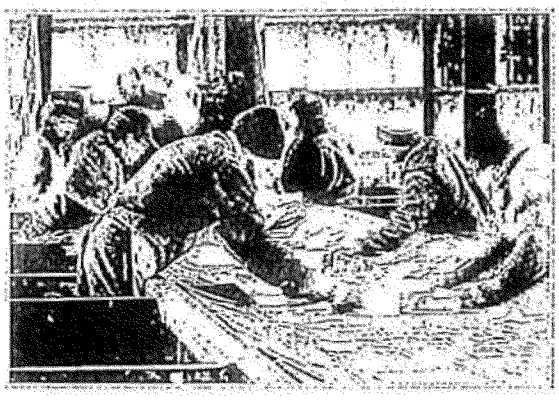
2015



JOHNDUNHAM & ASSOCIATES

Prepared for the **Institute for Scrap Recycling Industries, Inc.**

Executive Summary



Scrap recycling is a major U.S.-based industry dedicated to transforming end-of-life products and industrial scrap into new commodity grade materials and driving economies by making the old, new again. Recognized as one of the world's first green industries, scrap recycling creates and supports jobs and has a positive impact on the environment by reducing greenhouse gas emissions, saving energy, and protecting our natural resources.

In 2015, the Institute of Scrap Recycling Industries, Inc. (ISRI) retained the independent economic consulting firm of John Dunham and Associates (guerrillaeconomics.com) to perform an economic impact analysis to document the size and scope of the scrap recycling industry in the United States and document its significant contribution to the U.S. economy, in terms of employment, tax generation, and overall economic benefit.

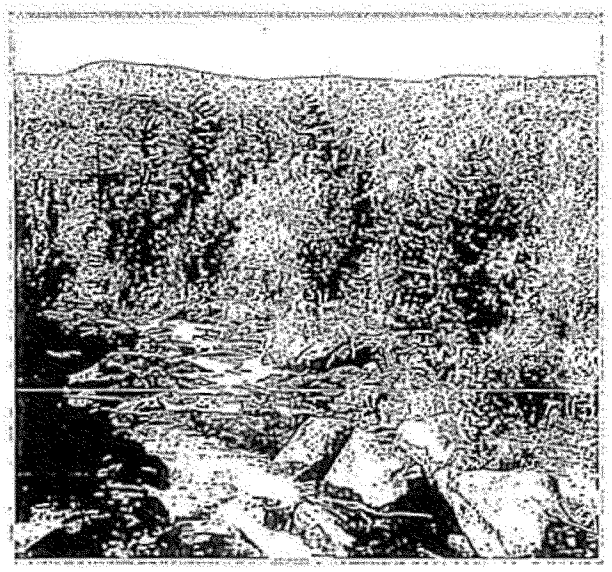
JOHN DUNHAM & ASSOCIATES

The U.S. scrap recycling industry is not only a thriving economic engine, but also a pivotal player in environmental protection, resource conservation, and sustainability. The industry recycled more than 135 million metric tons of materials in 2014, transforming outdated or obsolete scrap into useful raw materials needed to produce a range of new products.[1]

	Direct	Supplier	Induced	Total
Jobs	149,010	171,350	151,227	471,587
Wages	$11,496,501,800	$11,344,450,100	$7,950,256,600	$30,791,208,500
Economic Impact	$45,644,002,300	$35,727,836,800	$24,442,618,900	$105,814,458,000

Recycling reduces greenhouse gas emissions by significantly saving the amount of energy needed to manufacture the products that we buy, build, and use every day. The energy saved by recycling may then be used for other purposes, such as heating our homes and powering our automobiles.

In addition to being an environmental steward, the study confirmed that the U.S. scrap recycling industry plays a prominent role as an economic leader, job creator, and major exporter. Specifically, the study found that the people and firms that purchase, process, and broker old materials to be manufactured into new products in America provide 471,587 adults with good jobs in the United States[2] and generate more than $105.81 billion annually in economic activity.



1 Data from The ISRI Scrap Yearbook 2014, Institute of Scrap Recycling Industries, Inc. (ISRI)
2 Based on the Economic Impact of the Scrap Recycling Industry in the United States (2015), produced for the Institute of Scrap Recycling Industries, Inc. (ISRI) by John Dunham and Associates, 2015.

Summary of Findings

Employment Source of Green

While many in the public policy world talk about the need for more green jobs, the scrap recycling industry has already been creating these environmentally friendly jobs and other opportunities here in the United States for decades. The study found that in 2015, 149,010 jobs are being supported by the manufacturing and brokerage operations of the scrap recycling industry in the United States.[3] These are good jobs paying an average of $77,153 in wages and benefits to American workers. In addition to this, 322,577 jobs throughout the U.S. economy are indirectly supported by the scrap recycling industry through suppliers and the indirect impact of the industry's expenditures.[4]

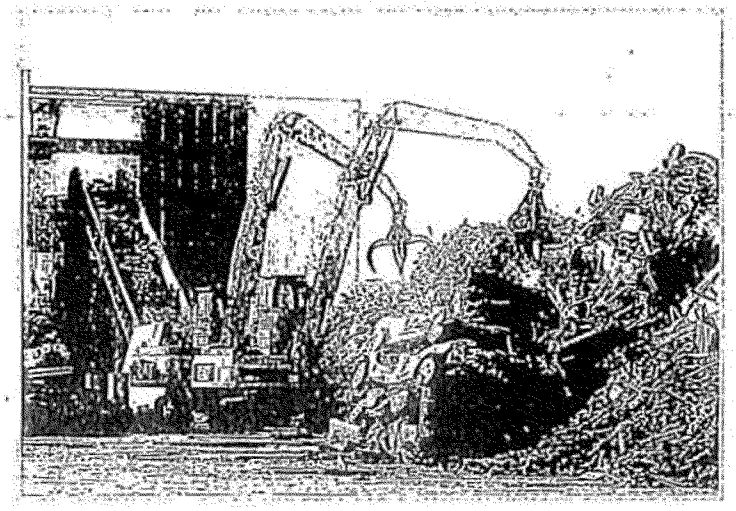
U.S. Scrap Recycling Industry Facilities

These are real people with real jobs -- not only in firms that process scrap materials into new, usable commodity inputs, but in firms that supply the industry with recycled materials, like auto yards and independent peddlers, as well as firms that supply machinery, trucks, and services to processors. In addition, thousands of people in industries seemingly unrelated to scrap materials recycling, from servers in restaurants, to construction workers, to teachers in local schools, depend on the re-spending of the wages and taxes paid by scrap recycling industry to their workers and suppliers.

The economic benefits generated by the scrap recycling industry are widespread. Not only are scrap facilities located in every state throughout the country and in both urban and rural communities, but the firms that supply materials, goods, and services to processors and brokers are also located in every part of the country. This means that the U.S. scrap recycling industry provides good-paying jobs in every state in the union. The study results are broken down by state, congressional district, and state legislative districts at ISRI.org/jobstudy.

3 This includes firms involved in the purchasing, processing, and brokering of scrap materials including ferrous and nonferrous metals, paper, electronics, rubber, plastics, glass, and textiles.
4 Direct impacts are those associated with scrap processors and brokers. Supplier impacts are associated with firms providing goods and services to scrap recyclers and brokers, including peddlers, and induced impacts are those resulting from the re-spending of wages by workers in the direct and supplier sectors.

Overall Economic Activity



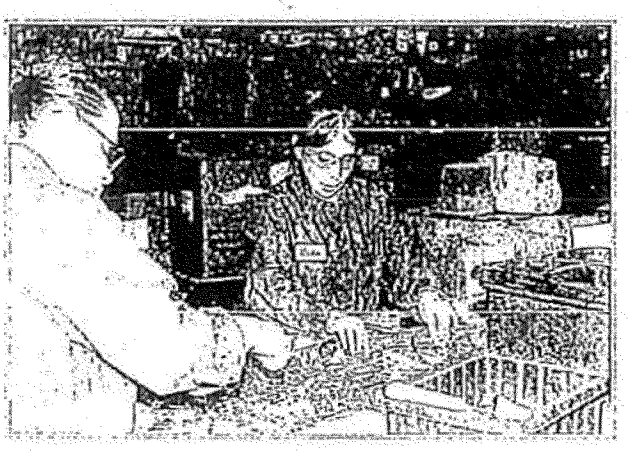
The activities of the scrap recycling industry in the United States generate nearly $105.81 billion annually in economic benefits here at home. All told, the U.S. scrap recycling industry accounts for 0.68 percent of the nation's total economic activity,[5] making it similar in size to the data processing and hosting industry, the dental industry, and the automotive repair industry.

Tax Revenues to Federal, State, and Local Governments

The scrap recycling industry generates substantial revenues for state and local governments throughout the United States, as well as for the federal government.

- The industry generates about $4.39 billion in state and local revenues annually, revenues that are used to help communities and people throughout the country.
- Another $6.76 billion in federal taxes are paid annually by the industry and its employees.

Export Activities: Creating Thousands of Jobs Here at Home



Scrap commodities are among the nation's largest exports by value, and overall, exports account for 26.79 percent of the industry's economic activity. These exports create approximately 125,276 good green jobs in the United States and help strengthen the national economy. According to the study, in 2015, 39,022 jobs are directly supported by the export activities associated with the processing and brokerage operations of scrap recyclers operating in the United States.[6] An additional 86,254 jobs are supported by supplier operations and through the indirect effects of scrap recycling exports. These jobs pay a total of $5.43 billion in wages. All of this activity generates $28.34 billion in economic benefits in the United States and contributes $1.31 billion in tax revenues for the federal government and $1.65 billion in state and local taxes.

Summary Table: Economic Impact of U.S. Scrap Recycling Exports

	Direct	Supplier	Induced	Total
Jobs	39,022	46,023	40,231	125,276
Wages	$3,082,127,100	$3,189,718,500	$2,241,913,200	$8,513,758,800
Economic Impact	$12,086,507,400	$9,575,993,600	$6,682,391,100	$28,344,892,100

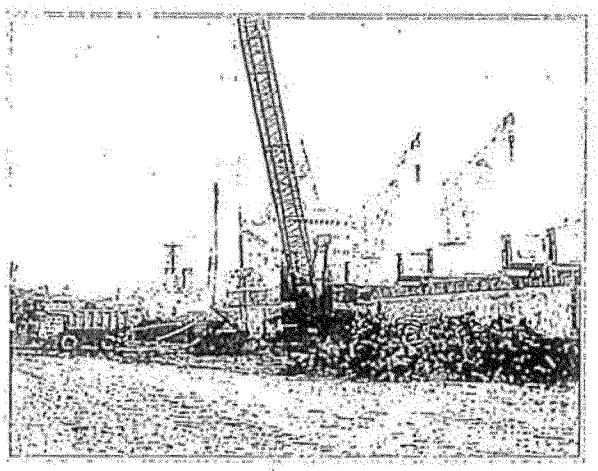
This is because scrap materials that are intended for export must be collected, separated, and prepared for transport out of the United States. The steps in this process provide well-paying U.S. jobs.

5 Bureau of Economic Analysis. GDP based on fourth quarter 2014, value of $17.703 trillion, see: *Gross Domestic Product: Fourth Quarter and Annual 2014* (Third Estimate); *Corporate Profits: Fourth Quarter and Annual 2014*, March 27, 2015.

6 This includes firms involved in the purchasing, processing, and brokering of scrap materials including ferrous and nonferrous metals, paper, electronics, rubber, plastics, glass, and textiles.

In fact, were it not for these export markets, many materials, including post-consumer paper and electronics, would probably not be recycled at all simply because there is limited demand for them in the United States.[7] By opening up new markets, the nation's recycled materials producers create demand for materials that might otherwise end up in landfills.

In the case of electronic products, for example, there simply is not enough demand in the United States for the more expensive post consumer materials, including gold and titanium, that may be smelted out of circuit boards, capacitors, and other electronic parts. On the other hand, countries like India, where demand for gold is particularly high, see value in these materials.[8]

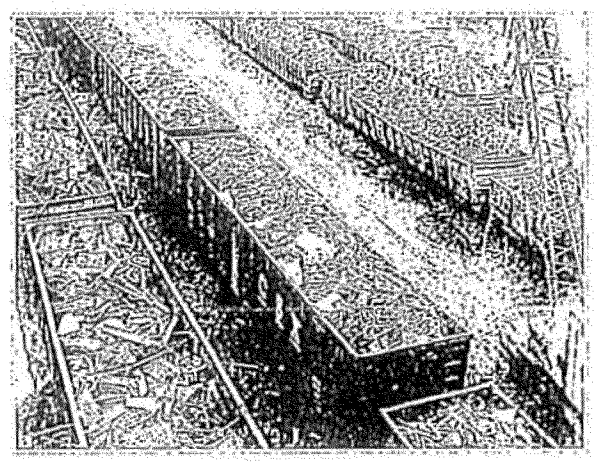


The scrap industry is the first link in the global supply chain for the growing demand of all manner of commodities ranging from iron and steel to paper, nonferrous metals such as aluminum, copper, and zinc, plastics, electronics, rubber, and more. The result is economic and environmental sustainability for our nation and our world through the supply of high quality, environmentally-friendly and energy saving raw materials to the global marketplace.

In 2014, the industry exported nearly $21 billion in commodity grade scrap products to more than 160 countries, significantly helping the U.S. balance of trade. In fact, in terms of volume, scrap materials are among the nation's largest commodity exports, in line with other important commodity export products like grain and corn, cotton, timber, and petroleum. The scrap materials processed in the United States are exported to other countries for manufacture into new products. Rather than encouraging the use of virgin materials, America's recycled materials help reduce worldwide energy demand and greenhouse gases as well as the need to mine and harvest virgin materials.

Economic Benefits of Exporting Scrap Commodities Are No Different Than Those That Occur Exporting Any Other Product

International trade is an important part of the American economy. In 2014, nearly $2.344 trillion in goods and services were exported from the United States, and about $2.849 trillion were imported.[9] More than 38 million Americans work for companies that engage in international trade, according to the U.S. Chamber of Commerce, and one in four manufacturing jobs depends on exports.[10]



7 One reason that so much waste paper is sent to China for reprocessing is that wood pulp is very expensive in Asia. In the United States, on the other hand, integrated paper manufacturers use a mixture of pre- and post-consumer recycled paper as well as wood pulp from specially raised forests to manufacture paper products.

8 India accounted for over one-quarter of world gold demand in the 2014. Together, India and China accounted for about 53 percent of world demand. The United States, on the other hand accounted for just about 5 percent. About 9 percent of India's gold comes from recycled materials. See Gold Demand Trends Full Year 2014 (http://www.gold.org/supply-and-demand/gold-demand-trends), World Gold Council, February 2015.

9 *US International Trade in Goods and Services: February 2015*, Press Release, US Department of Commerce, Bureau of Economic Analysis, April 17, 2015. Available on-line at: https://www.census.gov/foreign-trade/Press-Release/current_press_release/

10 *The Benefits of International Trade* (2014), US Chamber of Commerce, accessed April 2015, on-lie at: https://www.uschamber.com/international/international-policy/benefits-international-trade-0

The U.S. International Trade Association projects that U.S. exports supported an estimated 11.7 million jobs in 2014, up from 11.4 million in 2013.[11]

To suggest that the export of recycled commodities would somehow destroy jobs in the United States is no different than stating that the export of corn, or of coal, or of cotton, somehow takes away American jobs. In fact, President Barack Obama, in his first State of the Union address to Congress, highlighted exports as a pillar of economic growth on which the country will depend in the future.[12]

Economic and Job Impacts on a State-by-State Level

Economic Contribution of Scrap Recycling Industry, 2015
($ 000)
All Industries

	Direct			Suppliers			Induced			Total		
	Jobs	Wages	Output	Jobs	Wages	Output	Jobs	Wages	Output	Jobs	Wages	Output
Alabama	2,761	$204,013	$907,604	3,309	$185,810	$667,695	2,437	$102,321	$351,782	8,507	$492,144	$1,927,082
Alaska	201	$18,573	$61,911	271	$24,585	$94,054	234	$11,988	$38,135	706	$55,146	$194,100
Arizona	2,829	$352,417	$1,082,820	3,327	$210,073	$665,397	3,763	$185,658	$579,104	9,919	$748,148	$2,327,320
Arkansas	1,412	$86,056	$392,435	1,459	$78,609	$294,086	1,174	$49,790	$179,907	4,045	$213,454	$866,427
California	17,141	$1,362,434	$5,122,638	21,382	$1,543,308	$4,897,632	16,999	$1,047,445	$3,031,864	55,522	$3,953,186	$12,551,334
Colorado	1,917	$223,797	$609,318	2,182	$155,702	$443,038	2,535	$138,509	$398,433	6,614	$518,009	$1,450,789
Connecticut	1,408	$122,651	$437,581	1,269	$109,779	$311,687	1,339	$91,438	$290,340	4,014	$323,868	$1,039,608
Delaware	173	$13,018	$56,240	228	$17,360	$60,378	268	$14,307	$59,415	667	$44,685	$175,033
District of Columbia	58	$5,589	$33,113	173	$22,470	$40,552	272	$24,215	$39,769	503	$52,274	$113,434
Florida	7,082	$497,395	$1,804,691	8,736	$494,723	$1,398,651	8,551	$439,371	$1,285,157	24,749	$1,431,489	$4,488,540
Georgia	5,154	$345,585	$1,599,666	6,489	$386,961	$1,168,632	5,121	$252,471	$781,615	16,764	$985,027	$3,549,914
Hawaii	357	$26,416	$88,669	464	$30,584	$81,299	464	$21,388	$59,048	1,285	$78,388	$229,036
Idaho	456	$25,527	$127,519	611	$32,439	$116,467	559	$22,685	$78,003	1,626	$80,652	$322,889
Illinois	7,329	$722,391	$2,546,430	8,357	$629,683	$1,847,730	7,859	$452,302	$1,339,956	23,545	$1,804,376	$5,734,115
Indiana	4,556	$340,228	$1,807,481	5,198	$308,431	$1,196,236	4,090	$184,230	$639,647	13,844	$830,889	$3,643,364
Iowa	1,913	$103,602	$601,963	1,890	$99,073	$374,017	1,541	$87,305	$254,017	5,344	$289,981	$1,229,998
Kansas	1,232	$79,611	$300,813	1,170	$63,179	$232,595	1,186	$54,513	$198,316	3,588	$197,304	$731,723
Kentucky	2,808	$179,938	$867,086	3,056	$169,807	$612,239	2,311	$97,807	$323,388	8,175	$447,551	$1,802,713
Louisiana	1,902	$134,256	$454,585	1,936	$119,973	$537,105	1,832	$84,631	$287,673	5,670	$338,860	$1,379,366
Maine	649	$35,509	$148,542	723	$37,964	$110,284	617	$25,532	$77,290	1,989	$99,005	$336,116
Maryland	1,693	$123,833	$496,953	1,869	$129,012	$349,015	1,857	$107,017	$276,609	5,397	$359,861	$1,122,577
Massachusetts	2,948	$250,652	$859,033	3,155	$256,529	$637,664	3,037	$197,965	$509,401	9,138	$705,146	$1,997,098
Michigan	5,129	$373,712	$1,579,780	6,134	$382,205	$1,248,988	5,410	$257,852	$851,907	16,673	$1,013,770	$3,680,675
Minnesota	2,232	$148,343	$603,754	2,847	$200,556	$681,174	2,602	$140,850	$477,644	7,681	$489,750	$1,762,572
Mississippi	991	$60,238	$281,572	1,178	$58,796	$233,054	971	$38,042	$138,985	3,140	$157,076	$653,610
Missouri	3,572	$241,891	$1,028,908	3,379	$200,600	$601,636	3,204	$151,490	$472,151	10,155	$594,182	$2,102,695
Montana	372	$25,823	$161,882	396	$22,736	$69,238	396	$15,022	$46,030	1,166	$63,581	$288,051
Nebraska	930	$60,594	$365,637	1,083	$64,491	$218,273	952	$43,368	$149,957	2,965	$168,452	$573,866
Nevada	1,261	$92,190	$321,423	1,240	$87,641	$280,213	1,106	$52,855	$158,098	3,607	$232,685	$759,734
New Hampshire	668	$47,321	$164,523	631	$39,197	$113,267	621	$31,385	$90,450	1,940	$117,902	$368,240
New Jersey	5,353	$482,772	$1,683,469	4,642	$364,339	$975,321	4,088	$258,404	$736,426	14,083	$1,105,515	$3,395,236
New Mexico	518	$37,321	$153,498	585	$34,633	$128,017	603	$25,744	$76,558	1,706	$97,698	$358,072
New York	7,032	$546,762	$2,171,996	7,603	$691,008	$1,765,878	7,221	$499,334	$1,318,510	22,173	$1,738,064	$5,256,384
North Carolina	4,681	$291,901	$1,277,571	5,466	$302,679	$872,884	4,309	$208,615	$694,159	14,746	$803,194	$2,844,610
North Dakota	238	$22,438	$150,729	214	$13,951	$59,318	281	$13,947	$45,005	733	$50,337	$255,052
Ohio	8,750	$626,992	$2,538,605	9,702	$580,590	$1,917,421	8,228	$388,121	$1,237,174	26,680	$1,605,693	$5,793,400
Oklahoma	1,336	$79,746	$390,815	1,734	$87,325	$381,140	1,427	$64,059	$228,454	4,497	$241,130	$1,000,408
Oregon	2,189	$169,811	$617,832	2,596	$163,584	$539,109	2,235	$104,007	$404,002	7,021	$437,202	$1,560,742
Pennsylvania	7,089	$534,598	$2,450,096	6,214	$563,253	$1,784,245	6,947	$370,680	$1,103,944	22,250	$1,468,531	$5,338,285
Rhode Island	725	$51,425	$207,579	569	$35,812	$101,428	534	$26,727	$75,482	1,828	$113,964	$384,267
South Carolina	2,665	$252,608	$787,000	2,840	$164,711	$525,816	2,864	$114,588	$369,280	8,369	$532,200	$1,682,096
South Dakota	234	$11,140	$58,167	281	$13,034	$35,224	303	$12,252	$46,675	818	$36,426	$139,066
Tennessee	4,428	$338,963	$1,330,729	5,064	$298,935	$939,296	4,268	$208,580	$643,270	13,760	$846,478	$2,962,294
Texas	11,947	$946,889	$3,736,206	15,444	$1,045,558	$3,881,846	13,003	$888,874	$2,259,172	40,394	$2,881,321	$9,869,224
Utah	857	$71,136	$253,534	1,172	$67,966	$263,459	1,269	$56,721	$189,209	3,298	$195,872	$696,202
Vermont	221	$13,092	$56,744	231	$10,923	$39,405	243	$8,002	$29,593	695	$33,018	$125,738
Virginia	2,970	$209,987	$936,892	3,186	$227,779	$619,407	2,747	$152,658	$429,542	8,903	$590,424	$1,985,840
Washington	2,831	$277,880	$957,225	3,172	$230,533	$693,302	3,185	$175,154	$533,293	9,188	$683,567	$2,183,721
West Virginia	695	$37,606	$148,017	782	$54,146	$205,697	578	$23,449	$79,845	2,056	$115,201	$433,561
Wisconsin	2,743	$180,001	$699,330	3,158	$183,382	$556,317	2,912	$139,016	$465,439	8,843	$502,399	$1,761,086
Wyoming	169	$9,722	$33,759	235	$18,646	$94,164	183	$8,466	$29,605	578	$37,134	$157,427
Total	149,010	$11,498,502	$45,644,002	171,350	$11,344,450	$35,727,837	151,227	$7,950,257	$24,442,619	471,587	$30,791,209	$105,814,458

John Dunham and Associates: 2015

The study also calculated the impact of the U.S.-based scrap recycling industry on a state-by-state basis (as well as by state legislative district). The table above summarizes those impacts. Specific tables -- by state, congressional district, and state legislative district -- can be found at ISRI.org/jobstudy.

11 *Jobs Supported by Exports 2014: An Update*: March 4, 2015, International Trade Association. Available on-line at: http://www.trade.gov/mas/ian/build/groups/public/@tg_ian/documents/webcontent/tg_ian_005406.pdf

12 *International Trade Administration*, ITA News Letters. Available on-line at: http://trade.gov/press/publications/newsletters/ita_0210/nel_0210.asp

Study Methodology

The Scrap Recycling Industry Economic Impact Study estimates the economic contributions made by the various components of the scrap processing industry to the U.S. economy in 2015. John Dunham and Associates conducted this research, which was funded by the Institute of Scrap Recycling Industries, Inc. (ISRI). This work used standard econometric models maintained by the IMPLAN Group LLC. Data came from industry sources, government publications, and Dun and Bradstreet, Inc. (D&B). The study defines the scrap recycling industry as firms in the private sector involved in the processing and brokerage of scrap metals, plastics, rubber, paper, textiles, glass, and electronics. The study measures the number of jobs in the sector, the wages paid to employees, the value added, and total output.

The study also estimates taxes paid by the industry and its employees. Federal taxes include industry-specific excise and sales taxes, business and personal income taxes, FICA, and unemployment insurance. State and local tax systems vary widely. Direct retail taxes include state and local sales taxes, license fees, and applicable gross receipt taxes. Processors pay real estate and personal property taxes, business income taxes, and other business levies that vary in each state and municipality. All entities engaged in business activity generated by the industry pay similar taxes.

The economic impact study begins with an accounting of the direct employment in the processing of recycled scrap materials and the materials brokerage sectors. The data come from a variety of government and private sources. It is sometimes mistakenly thought that initial spending accounts for all of the impact of an economic activity or a product. For example, at first glance it may appear that consumer expenditures for a product are the sum total of the impact on the local economy. However, one economic activity always leads to a ripple effect whereby other sectors and industries benefit from this initial spending. This inter-industry effect of an economic activity can be assessed using multipliers from regional input-output models.

Industries are linked to each other when one industry buys from another to produce its own products. Each industry in turn makes purchases from a different mix of other industries, and so on. Employees in all industries extend the economic impact when they spend their earnings. Thus, economic activity started by the scrap recycling industry is linked to other industries in the state and national economies. The activities required to process a ton of scrap iron; from sorting, to cutting, to baling, to shipping, generate the direct effects on the economy. Regional (or indirect) impacts occur when these activities require purchases of goods and services, such as machinery or electricity, from local or regional suppliers. Additional induced impacts occur when workers involved in direct and indirect activities spend their wages. The ratio between induced economic and direct impact is termed the multiplier.

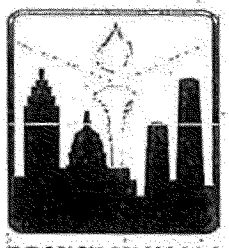
Once the direct impact of the industry has been calculated, the impact of supplier firms, and the "Induced Impact" of the re-spending by employees of industry and supplier firms, is calculated using an input/output model of the United States. The study calculates the impact on a national basis, by state, by congressional district, and by state legislative district.

This method of analysis allows the impact of local production activities to be quantified in terms of final demand, earnings, and employment in the states and the nation as a whole. In the case of the ISRI model, only the most conservative estimate of the induced impact has been used.

Additional detail on the methodology used for this study can be found in ISRI.org/jobstudy.

Scrap Recycling Industry Impact Summary and Methodology John Dunham and Associates, 2015 (guerrillaeconomics.com)

Institute of Scrap Recycling Industries Inc. (ISRI)
1615 L Street, NW, Suite 600
Washington, DC 20036



Answers to your questions about recycled rubber

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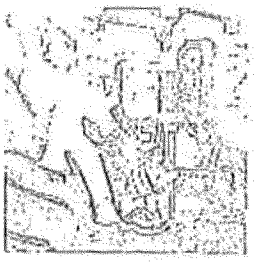
Recycled rubber plays a vital yet largely unseen role in our lives. We interact with it on a daily basis and it enables us to do many of the things we love the most.

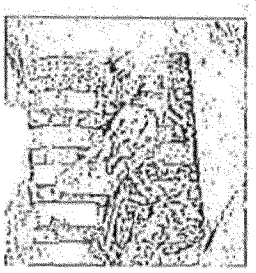


What is recycled rubber?

Recycled rubber is rubber that has been derived from scrap materials such as used tires.

Recycled rubber gives us innovative ways to reduce waste while solving important challenges – from facilitating softer playground surfaces, to reducing the chance of injuries for athletes, to building lower-impact hospital floors for nurses on their feet all day.

U.S. scrap rubber manufacturers recycle roughly 110 million tires annually – or one tire for every three people in the U.S.

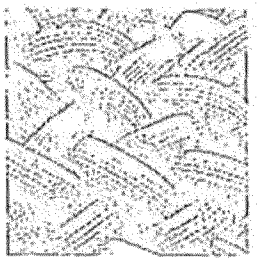


How is it made?

Recycled rubber is produced from scrap tires through a straightforward process. There are two main ways in which this happens:

- AMBIENT SHREDDING uses powerful, interlocking knives to chop tires into smaller pieces.
- CRYOGENIC PROCESS uses liquid nitrogen to freeze them at sub-zero temperature. These cold temperatures cause the physical properties of the tire to change, and it becomes very brittle. The tire is then placed in an enclosure in which powerful hammers smash the tire apart.

The non-rubber portions of the tire are also recycled. For example, the steel beads that give the tire its shape and structure are recovered by recyclers and processed into specification grade product used by steel mills for new steel.



Why should we be recycling scrap tires?

Tires, designed to be virtually indestructible under a variety of conditions, have historically been difficult to dispose of or recycle.

In most cases, old and worn tires were replaced with newer tires and dumped illegally in lakes, empty lots, along the sides of roads, and in nature in potentially sensitive habitats. Others were added to landfills.

Today, thanks to innovations in manufacturing, scrap tire rubber is used to make new tires, playground surfaces, equestrian mats, and rubberized asphalt—among other products.

Tire recycling is an economically sound, environmentally-friendly activity that can contribute to the reduction of a product's overall carbon footprint by anywhere from four to 20 percent when compared to virgin plastic resins.

Benefits of Recycled Rubber

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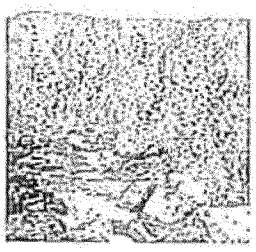
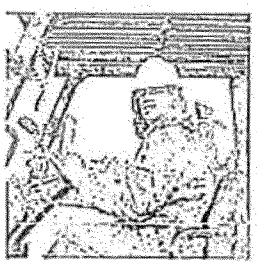


Environmental Benefits:

Recycling rubber tires means that millions of scrap tires are no longer dumped in landfills, or left illegally in lakes, abandoned lots, along the side of the road and in sensitive habitats. Instead, more than 90 percent of these tires are being recycled and reused annually.

Recycling saves impressive amounts of energy, which ultimately reduces greenhouse gas emissions. For example, recycling four tires reduces CO_2 by about 323 pounds, which is equivalent to 16 gallons of gasoline.

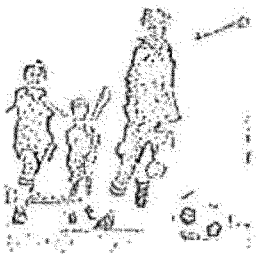
Using recycled rubber in molded products, for example, creates a substantially smaller (by a factor of up to 20 times) carbon footprint as compared to using virgin plastic resins



Economic Benefits:

In addition to being an environmental steward, the rubber recycling industry plays a prominent role as both an economic leader and job creator.

According to a 2015 study conducted by John Dunham and Associates, the rubber recycling industry generates more than **$1.6 billion annually in economic activity.** This includes, providing nearly **8,000 good paying jobs** (direct and indirect) in all 50 states that generate more than **$500 million in employee wages** and **$182 million** in federal, state, and local tax revenues.



Expanding Opportunity through Design:

Recycled rubber is being used by manufacturers in a wide variety of applications today. Manufacturers prize scrap as a raw material input due in part to cost and energy savings.

Here are a number of settings where we see recycled rubber most:

MEDICAL: Hospital floors and surgical gloves
– *providing comfort and quiet for medical professionals and patients*

AGRICULTURE: Vegetation protectors and windbreaks, sheds, livestock mats, bumpers, and feeders
– *increasing yield and efficiency for the agricultural sector*

SPORTS: Infill for synthetic turf fields (of which there are more than 12,000 in the U.S.), indoor and outdoor running tracks, and fitness mats
– *broadening sports and fitness opportunities across the country*

PLAYGROUND SURFACES: Mulch and mats
– *cushioning our children's falls*

INFRASTRUCTURE: Rubberized asphalt on roadways
– *providing surface durability while lessening traffic noise*

OTHER: Landscaping mulch, molded products such as railroad ties, flowerpots, garden hoses, benches, and welcome mats
– *creating useful everyday products*

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Where Do We Recycled Rubber?

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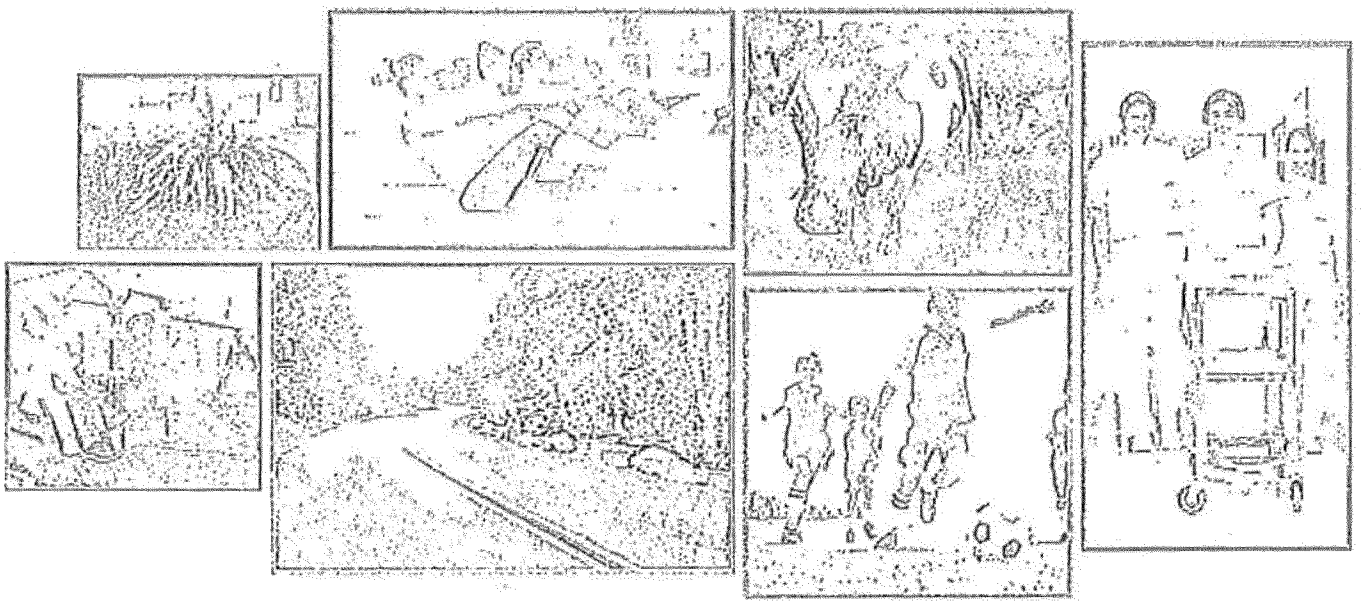

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Benefits

Environmental

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Economic

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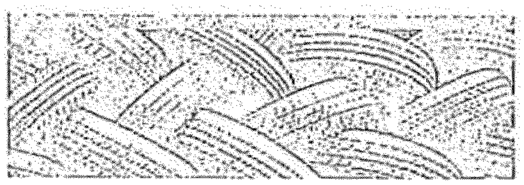

Safe Fields Alliance

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The Facts About Recycled Rubber

America drives, works, and plays on Recycled Rubber

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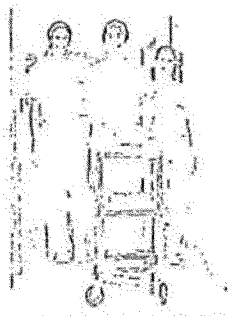
- Roughly 110 million tires are recycled or reused annually—or one tire for every three people in the U.S.

Why should we be recycling scrap tires?

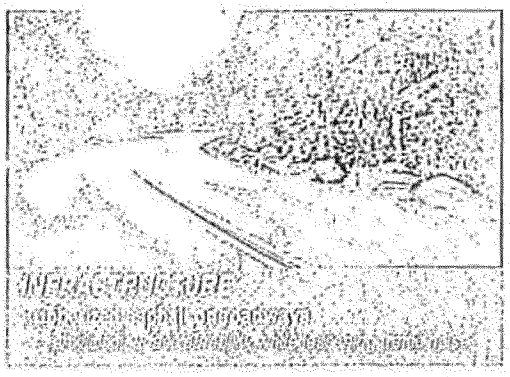
- Tires, designed to be virtually indestructible under a variety of conditions, have historically been difficult to dispose of or recycle.
- In most cases, old and worn tires were replaced and dumped illegally in nature and in potentially sensitive habitats. Others were added to landfills.
- Scrap tire rubber is used to make new tires, playground surfaces, equestrian mats, and rubberized asphalt—among other products.
- Tire recycling is an economically sound, environmentally-friendly activity that can contribute to the reduction of a product's overall carbon footprint by anywhere from four to 20 percent when compared to virgin materials.

Recycling today

Recycled tires and rubber are being used by manufacturers in a wide variety of applications today. Manufacturers prize scrap as a raw material input due in part to cost and energy savings in the following settings:



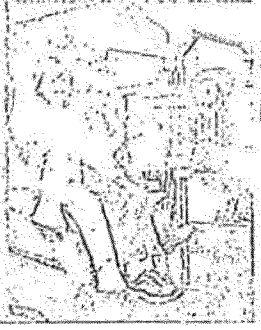
MEDICAL
Hospital floors and surgical gloves
- *providing comfort and quiet for medical professionals and patients*



INFRASTRUCTURE
Noise and pollution barriers

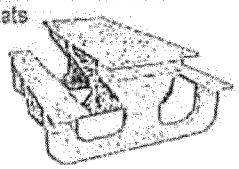
AGRICULTURE
Vegetation protectors and windbreaks, sheds, livestock mats, bumpers, and feeders
- *increasing yield and efficiency for the agricultural sector*

SPORTS
Infill for synthetic turf fields (of which there are more than 12,000 in the U.S.), indoor and outdoor running tracks, and fitness mats
- *broadening sports and fitness opportunities across the country*



PLAYGROUND SURFACES
Mulch and mats
- *cushioning our children's falls*

OTHER
Landscaping mulch, molded products such as railroad ties, flowerpots, garden hoses, benches, and welcome mats
- *creating useful everyday products*



Frequently Asked Questions

The Synthetic Turf Council provides the community with honest responses to their most frequently asked questions. We have compiled answers within the following topical categories:

- Synthetic Turf – General
- Health & Environmental Impact
- Player Usage & Injuries
- Cost, Installation, Maintenance and Disposal

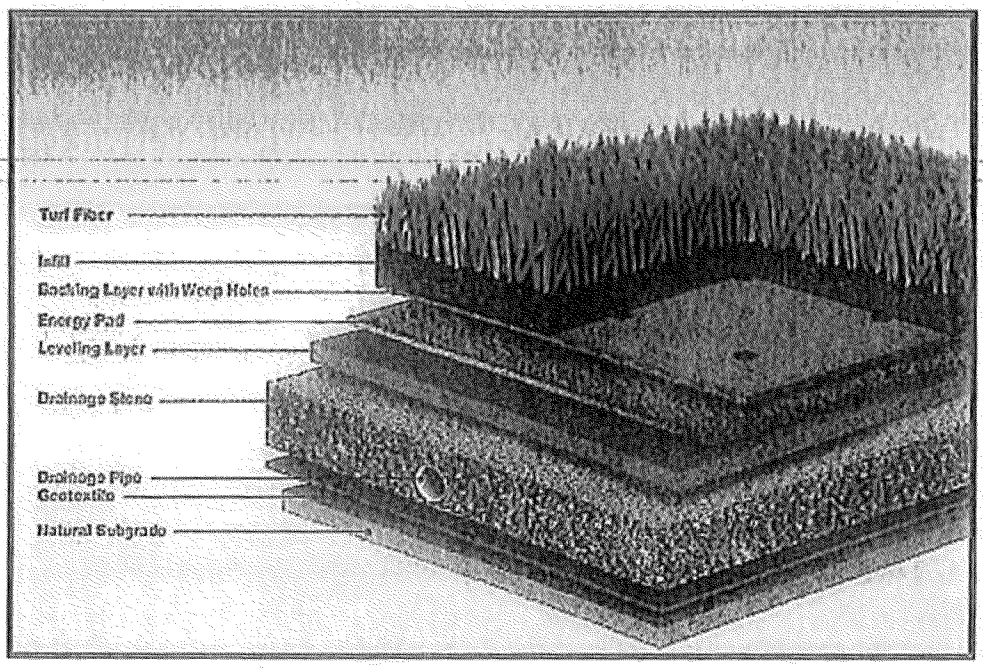
SYNTHETIC TURF – GENERAL

Q: What is synthetic turf?

The latest generation of synthetic turf is a grass-like ground cover that replicates lush natural grass in appearance and function. When used on athletic fields, it provides a consistent year-round, all-weather playing surface built to withstand extended use without downtime for recovery. As a landscape cover, synthetic turf provides a low maintenance, weed-free surface that doesn't need to be watered or fertilized, and is available in styles that look like the grass types that are prevalent locally.

Q: How is synthetic turf made?

Most synthetic turf systems installed today include a drainage layer, a multi-layered backing system, and resilient "grass" blades that are infilled with a granular filler to resemble natural turf. "Infilled" means that the man-made grass blades are interspersed with a top soil created with sand and/or granulated recycled tire rubber or other infill materials that provide the necessary stability, uniformity, and resiliency. Each blade customarily stands above the infill material. The typical blade length and system characteristics are determined by the specific activity requirements. In some applications, the synthetic turf system includes a pad or elastic layer underneath the turf, often in combination with lower pile height and less infill.



Q: How is the new generation of synthetic turf different from that of the past?

Increasing demand for high quality playing surfaces and intense competition for field accessibility has given rise to a new generation of synthetic turf systems that replicate the look and feel of lush, natural grass. While the first artificial turf systems used in the 1960's and 1970's were hard, significant advancements have been made during the past few decades. By the 1990's, the first synthetic turf systems with sand and rubber infill were introduced, which dramatically improved player performance and safety. Today's synthetic turf, used by many NFL franchises, as well as member associations and teams of the **Union of European Football Associations** (UEFA), **Fédération Internationale de Football Association** (FIFA), the **International Rugby Board** and other international sports federations, combines the playing characteristics, look and feel of natural turf, with the advantages of increased frequency of usage, extra revenue generation, safety, longer playing sessions, fewer canceled games, and lowest cost per playing day.

Q: Why has synthetic turf become so popular over the past few years?

Synthetic turf is a smart solution for playing fields and landscape that have become unsafe and unsightly from overuse or severe climatic conditions. A grass field simply cannot remain lush and resilient if it is used more than three to four days a week, or in the rain, or during the months when grass doesn't grow. This fact, coupled with an escalating need for durable fields that accommodate multiple sports teams and activities, the high cost of maintaining a grass sports field, and the need to conserve water, have prompted a rising number of schools and parks to

turn to synthetic turf to meet their program needs. Today's synthetic turf is designed to simulate the experience of practicing and playing on the best grass fields.

Demand has grown to the point where more than 8,000 multi-use synthetic turf sports fields are now enjoyed in North American schools, colleges, parks and professional sports stadiums. About half of all NFL teams currently play their games on synthetic turf and, since 2003, over 70 FIFA U-17 and U-20 World Cup matches have been played on synthetic turf soccer fields.

Q: How popular is synthetic grass for landscape and recreation use?

Synthetic grass for landscape, golf and other recreation applications is the fastest growing segment of the synthetic turf market. Over 35 million square feet of synthetic grass for landscape and recreation use was installed in 2012.

Q: How is synthetic turf being used in the landscape and recreation market?

Thousands of homes, businesses, golf courses, municipalities, parks and tourist attractions like Disneyland and Steve Wynn's Las Vegas resorts have turned to synthetic grass to provide a lush, attractive landscape solution that requires minimal resources and maintenance while saving millions of gallons of water each year. It is also a smart way to beautify public spaces such as highway medians and airport landing strips that would otherwise be difficult and expensive to maintain. Synthetic grass reduces city maintenance costs, freeing tax dollars for other purposes.

Synthetic turf also promotes greater utilization of land, as you can do more with the same space surface than with natural grass. Rooftops once deemed unusable for high rises and residential buildings can now feature inviting green area. Hotels that had to restrict the use of lawns for parties and events can now schedule as many functions as they can book.

Q: What are the different types of infill materials?

Crumb Rubber: Crumb Rubber is derived from scrap car and truck tires that are ground up and recycled. Two types of crumb rubber infill exist: Ambient and Cryogenic. Together these make up the most widely used infill in the synthetic sports field and landscape market. Crumb rubber infill is substantially metal free, and, according to the STC Guidelines for Crumb Rubber Infill, should not contain liberated fiber in an amount that exceeds .01% of the total weight of crumb rubber, or .6 lbs. per ton.

Coated Rubber Infill: Both ambient and cryogenic rubber can be coated with colorants, sealers, or anti-microbial substances if desired. Coated rubber provides additional aesthetic appeal, reduction of dust by products during the manufacturing process and complete encapsulation of the rubber particle.

EPDM Infill: EPDM (Ethylene Propylene Diene Monomer) is a polymer elastomer with high resistance to abrasion and wear and will not change its solid form under high temperatures.

Typical EPDM colors are green and tan. EPDM has proven its durability as an infill product in all types of climates. Its excellent elasticity properties and resistance to atmospheric and chemical agents provide a stable, high performance infill product.

Organic Infill: There are several organic infills available in the North American market, all utilizing different organic components, such as natural cork and/or ground fibers from the outside shell of the coconut. These products can be utilized in professional sports applications as well as for landscaping. At the end of its life cycle it can be recycled directly into the environment.

Sand (Silica) Infill: Pure silica sand is one of the original infilling materials utilized in synthetic turf. This product is a natural infill that is non-toxic, chemically stable and fracture resistant. Silica sand infills are typically tan, off-tan or white in color and - depending upon plant location – may be round or sub-round in particle shape. As a natural product there is no possibility of heavy metals, and the dust/turbidity rating is less than 100. It can be used in conjunction with many other infills on the market to provide a safe and more realistic playing surface. The round shape plays an integral part in the synthetic turf system. It is important that silica sand have a high purity (greater than 90%) to resist crushing and absorption of bacteria and other field contaminants. Silica sand can either be coated with different materials as a standalone product or can be used to firm up in combination with traditional crumb rubber infill systems.

Coated Silica Sand Infill: This class of infill consists of coated, high-purity silica sand with either a soft or rigid coating specifically engineered for synthetic turf. These coatings are either elastomeric or acrylic in nature (non-toxic) and form a bond with the sand grain sealing it from bacteria to provide superior performance and durability over the life of a field. Coated sand is available in various sizes to meet the application's needs.

Depending on the amount and type of infill, coated sands can either be used with or without a pad and are available in various colors. All of the coatings are non-toxic and are bonded to the quartz grain for superior performance and durability over the life of your field. These materials are typically used as a homogenous infill which provides both ballast and shock absorbing qualities to a synthetic turf application.

TPE Infill: Thermo plastic elastomer (TPE) infill is non-toxic, heavy metal free, available in a variety of colors that resist fading, very long lasting, and 100% recyclable and reusable as infill when the field is replaced. TPE infill, when utilizing virgin-based resins, will offer consistent performance and excellent *g*-max over a wide temperature range.

HEALTH & ENVIRONMENTAL IMPACT

Q: How does synthetic turf impact the environment?

Synthetic turf has a measurable, positive impact on the environment. Depending on the region of the country, a typical grass sports field requires between 500,000 to a million gallons of water or

more each year. During 2010, between four to eight billion gallons of water were conserved through its use. According to the **U.S. Environmental Protection Agency** (EPA), the average American family of four uses 400 gallons of water a day. Therefore, a savings of four to eight billion gallons of water equates to the annual water usage of over 27,000 to 55,000 average American families of four.

Tax credits and rebates are being offered to residential and corporate users by an increasing number of local governments in light of the tremendous impact on water conservation. The **Southern Nevada Water Authority** estimates that every square foot of natural grass replaced saves 55 gallons of water per year. If an average lawn is 1,800 square feet, then Las Vegas homeowners with synthetic turf could save 99,000 gallons of water each year or about $400 annually. In Atlanta, homeowners could save $715 a year, not including much higher sewer charges.

The estimated amount of synthetic turf currently installed has eliminated the need for millions of pounds of harmful pesticides and fertilizers, which has significant health and environmental implications. For example, according to the **North Carolina Department of Environment and Natural Resources**, polluted storm water runoff is the number one cause of water pollution in their state, with common examples including over fertilizing lawns and excessive pesticide use.

In addition, synthetic turf helps reduce noxious emissions (the EPA reports that a push mower emits as much pollution in one hour as 11 cars and a riding mower emits as much as 34 cars) and reduces grass clippings, which the EPA states are the third largest component of municipal solid waste in landfills.

Q: Is synthetic turf safe?

More than 50 independent and credible studies from groups such as the **U.S. Consumer Product Safety Commission**, and statewide governmental agencies such as the **New York State Department of Environmental Conservation, New York State Department of Health** and the **California Environmental Protection Agency**, have validated the safety of synthetic turf (see **Position Statements** to learn more).

Recent highlights include:

- In October 2010, the California Office of Environmental Assessment completed its multi-year study of air quality above crumb rubber infilled synthetic turf, and bacteria in the turf, and reported that there were no public health concerns.
- In July 2010, the Connecticut Department of Public Health announced that a new study of the risks to children and adults playing on synthetic turf fields containing crumb rubber infill shows "no elevated health risks."
- The California EPA released a report dated July 2009 which indicated there is a negligible human health risk from inhaling the air above synthetic turf.

- Independent tests conducted by the New York State Department of Environmental Conservation and New York State Department of Health, released in May 2009, proved there were no significant health concerns at synthetic turf fields.
- In July 2008, a U.S. Consumer Product Safety Commission staff report approved the use of synthetic turf by children and people of all ages.

Q: Should I be concerned about lead in my field?

Absolutely not. In April 2008, concerns about lead in synthetic turf arose when elevated levels were found in several New Jersey fields. At the time, the lead chromate that was used to promote colorfastness in synthetic turf was encapsulated to prevent it from being readily absorbed by the body or released into the environment. The issue was resolved, and the safety of synthetic turf was validated on July 30, 2008 when the U.S. Consumer Product Safety Commission staff released the results of its study of lead in synthetic turf, and concluded that "young children are not at risk from exposure to lead in these fields." Here is their full statement. In over 40 years there has never been an instance of human illness or environmental damage caused by synthetic turf.

Today, synthetic turf is made without lead as a pigment ingredient. This change in the pigment formulations was a voluntary and responsible response by the synthetic turf industry to the CPSC's request of all industries that lead be removed from all products, if possible.

Q: Is crumb rubber safe?

Yes. Crumb rubber infill, made from reclaimed tires, is a popular infill option for many synthetic turf fields. It has been safely utilized since being introduced in 1997, and in playgrounds and tracks for much longer. This resilient material provides enhanced durability and safety. Its use in synthetic turf sports fields and landscape has also kept more than 105 million used tires out of landfills. Crumb rubber has been critically examined and studied since the late 1980's. Science has proven it to be safe for children and people of all ages (see Independent Research to learn more).

Q: What impact does heat have on my synthetic turf field?

During the summer months on hot sunny days, when synthetic turf is exposed to direct sunlight, some synthetic turf fields have reported surface temperatures significantly hotter than the surface temperature of a natural turf field. In such conditions, many coaches will schedule practices and games for the cooler times of day, and limit the number and duration of practices. They will also follow, as STC advocates, the heat-acclimation guidelines published by the National Athletic Trainers' Association.

Some field managers might opt to water their fields, while others advocate misting the athletes and keeping them properly hydrated. A misting station normally needs only five gallons of water

per hour based on full use. On a typical day, when the heat is at its peak for four to six hours, that equals 20 to 30 gallons of water.

Q: Are athletes playing on a synthetic turf more susceptible to MRSA/staph infections?

MRSA and other staph infections strike due to poor hygiene, regardless of type of playing surface. That's because it is spread by people in close contact with each other, like athletic team members, healthcare providers and patients, children in day care centers, military recruits, firefighters, and many other groups. Recent studies are in agreement. A California EPA report dated July 2009 stated "it is unlikely that the new generation of artificial turf is itself a source of MRSA."

A Penn State University study released in January 2009 found there was no difference in survival rates of staph on natural grass and synthetic turf surfaces. In addition, it stated that synthetic turf is not a hospitable environment for microbial activity such as staph. The issue goes beyond abrasions, since athletes can get cuts on any playing field – from the most well-manicured or dirt-compacted natural grass to state-of-the-art synthetic turf fields that are regularly irrigated and cleaned.

Q: How can I learn more about scientific studies on the health and environmental safety of synthetic turf?

See Independent Research to view unfiltered U.S. and international studies, links to industry resources and new position statements as materials are developed.

PLAYER USAGE & INJURIES

Q: What impact does synthetic turf have on playing time?

Synthetic turf playing fields exponentially increase playing and practice time because they can be used daily and in all types of weather, without worry of damage. Playability is enhanced since the fields remain uniform and consistent, season after season. They can also be used within hours of installation. In addition, while turf grass managers recommend against using a natural field for more than 20 – 24 hours per week or 680 – 816 hours per year for a three-season window, synthetic turf can be utilized around 3,000 hours per year with no "rest" required.

Q: How does synthetic turf compare to natural grass on player injury rates?

Made with resilient materials for safety, synthetic turf sports fields are always ready to play on. Traction, rotation and slip resistance, surface abrasion and stability meet the rigorous requirements of the most respected sports leagues and federations.

So it's no surprise that recent studies indicate that the injury risk of playing on synthetic turf is no greater than natural grass:

Three 2010 long-term studies published by researchers from Norway and Sweden compared acute injuries on synthetic turf and natural grass. The studies examined the type, location and severity of injuries sustained by hundreds of players during thousands of hours of matches and training over a four to five year period. Many types of acute injuries to men and women soccer players, particularly knee injury, ankle sprain, muscle strains, concussions, MCL tears, and fractures were evaluated. The researchers concluded that the injury risk of playing on artificial turf is no greater than playing on natural grass;

An analysis by FIFA's Medical Assessment and Research Centre of the incidence and severity of injuries sustained on grass and synthetic turf during two FIFA U-17 World Championships. According to FIFA, "The research showed that there was very little difference in the incidence, nature and causes of injuries observed during games played on artificial turf compared with those played on grass."

A 2004 NCAA study among schools nationwide comparing injury rates between natural and synthetic turf found that the injury rate during practice was 4.4% on natural turf, and 3.5% on synthetic turf.

COST, INSTALLATION, MAINTENANCE & DISPOSAL

Q: What are the advantages of contracting with an STC member company?

The STC recommends that you hire a team of professional contractors who are STC members and, if possible, STC Certified members, that you select with the help of a landscape architect and engineer or independent consultant. Visit the Buyers' Guide and Member Directory to help with your search.

Q: How long can a synthetic turf field be used?

Synthetic turf sports fields are typically warranted for eight years, but their life expectancy will depend to a great extent on the amount and type of usage and the maintenance it receives. When it comes to landscape applications, synthetic turf can last much longer than fields.

Q: How does the cost of a synthetic turf field compare to a natural turf field?

A synthetic turf field usually has a higher upfront cost, but the field often pays for itself over 3-4 years, proving to be a highly cost-effective investment. Synthetic turf fields are typically utilized for about 3,000 hours of play per year, with no "rest" required, the equivalent of three to four well-maintained natural turf fields. In addition, synthetic turf maintenance costs are two to three times less than natural turf, since no mowing, irrigation or chemicals are needed. Because of its consistent availability, a synthetic turf field is also a reliable source of rental revenue for schools and communities.

According to Cory Jenner, a landscape architecture professional in Syracuse, N.Y., the cost of installing and maintaining a synthetic turf sports field over a 20-year period (including one replacement field) is over three times less expensive per event than the cost of a grass field over the same period of time. This is because many more events can be held on a synthetic turf sports field. "Financially speaking, artificial turf is more cost-effective over time," Jenner said. This cost per event advantage is validated by other authorities and field owners.

Q: Are all synthetic turf products the same?

No, there are a variety of different types of synthetic turf products and systems. Visit the Buyers' Guide & Member Directory to browse synthetic turf manufacturers and system builders.

Q: Can synthetic turf hold up under heavy use?

Yes, one of the important advantages of synthetic turf is its ability to hold up under very heavy use. While natural turf shouldn't be played on during or immediately after a rain storm, after the application of pesticides and fertilizers, or during the months when grass doesn't grow, synthetic turf is always ready for play. Regular maintenance is important to enable synthetic turf to withstand the heavy use that it is often subjected to.

Q: Does synthetic turf fade?

Synthetic turf is U.V. stabilized to provide colorfastness, and the warranty typically includes a guarantee against fading for a certain number of years. Be aware of the relative impact that ultra violet rays can have on the life of your field – the greater the intensity of the sunlight, the shorter the lifespan of the fiber. Ask the turf vendor for this information. A field in Texas will not last as long as the same field in Maine.

Q: Who should I consult for the installation of a synthetic turf sports field?

The STC recommends that you hire a team of professional contractors that you select with the help of a landscape architect and engineer or independent consultant. Visit the Buyers' Guide and Member Directory to help with your search.

Q: Is maintenance of synthetic turf required?

While much less time and money is required to maintain a synthetic turf sports field than a natural grass field, synthetic turf needs to be maintained to maximize playability and the life of the product. The STC's Guidelines for Maintenance of Infilled Synthetic Turf Sports Fields (available in English and Spanish) provides essential guidance on proper maintenance techniques and frequency. The Buyers' Guide and Member Directory will also guide you to specific service providers.

Q: How will I know when my multi-purpose synthetic turf sports field is approaching the end of its useful life?

Please review the STC's Guidelines for Synthetic Turf Performance.

Q: What options are there for disposing of synthetic turf once it has reached the end of its useful life other than putting it in a landfill?

In January 2013, the STC published a review of the various options that exist for the Removal, Recovery, Reuse & Recycling of Synthetic Turf and Its System Components.

Q: Where do I turn for technical guidance?

The STC's member companies are the best source of technical guidance. Organizations are listed according to the product or service they provide in the Buyers' Guide and Member Directory. The STC Resource Center provides technical guidelines, suggestions for funding a field, marketing brochures and lots more information – all available for download without charge. Our website also offers latest research, position statements and white papers.

If you have questions or require additional information, please contact us at (678) 385-6720 or office@syntheticturfcouncil.org.

Answers to Your Questions on Recycled Rubber

RecycledRubberFacts.org

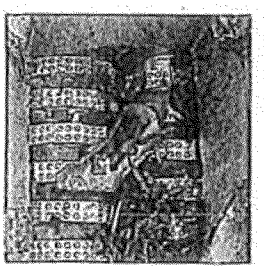
Recycled rubber plays a vital yet largely unseen role in our lives. We interact with it on a daily basis and it enables us to do many of the things we love the most.

What is recycled rubber?

Recycled rubber is rubber that has been derived from scrap materials such as used tires.

Recycled rubber gives us innovative ways to reduce waste while solving important challenges – from facilitating softer playground surfaces, to reducing the chance of injuries for athletes, to building lower-impact hospital floors for nurses on their feet all day.

U.S. scrap rubber manufacturers recycle roughly 110 million tires annually – or one tire for every three people in the U.S.

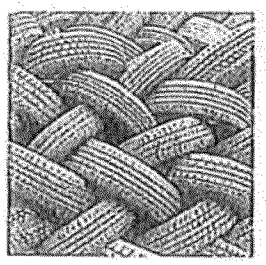


How is it made?

Recycled rubber is produced from scrap tires through a straightforward process. There are two main ways in which this happens:

- **AMBIENT SHREDDING** uses powerful, interlocking knives to chop tires into smaller pieces.
- **CRYOGENIC PROCESS** uses liquid nitrogen to freeze them at sub-zero temperature. These cold temperatures cause the physical properties of the tire to change, and it becomes very brittle. The tire is then placed in an enclosure in which powerful hammers smash the tire apart.

The non-rubber portions of the tire are also recycled. For example, the steel beads that give the tire its shape and structure are recovered by recyclers and processed into specification grade product used by steel mills for new steel.



Why should we be recycling scrap tires?

Tires, designed to be virtually indestructible under a variety of conditions, have historically been difficult to dispose of or recycle.

In most cases, old and worn tires were replaced with newer tires and dumped illegally in lakes, empty lots, along the sides of roads, and in nature in potentially sensitive habitats. Others were added to landfills.

Today, thanks to innovations in manufacturing, scrap tire rubber is used to make new tires, playground surfaces, equestrian mats, and rubberized asphalt—among other products.

Tire recycling is an economically sound, environmentally-friendly activity that can contribute to the reduction of a product's overall carbon footprint by anywhere from four to 20 percent when compared to virgin plastic resins.

Benefits of Recycled Rubber

RecycledRubberFacts.org

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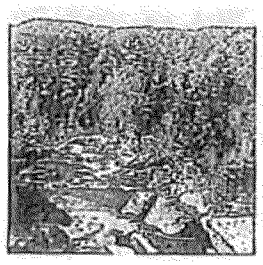

Environmental Benefits:

Recycling rubber tires means that millions of scrap tires are no longer dumped in landfills, or left illegally in lakes, abandoned lots, along the side of the road and in sensitive habitats. Instead, more than 90 percent of these tires are being recycled and reused annually.

Recycling saves impressive amounts of energy, which ultimately reduces greenhouse gas emissions. For example, recycling four tires reduces CO_2 by about 323 pounds, which is equivalent to 18 gallons of gasoline.

Using recycled rubber in molded products, for example, creates a substantially smaller (by a factor of up to 20 times) carbon footprint as compared to using virgin plastic resins

Economic Benefits:

In addition to being an environmental steward, the rubber recycling industry plays a prominent role as both an economic leader and job creator.

According to a 2015 study conducted by John Dunham and Associates, the rubber recycling industry generates more than **$1.6 billion annually in economic activity.** This includes, providing nearly **8,000 good paying jobs** (direct and indirect) in all 50 states that generate more than **$500 million in employee** wages and **$182 million** in federal, state, and local tax revenues.

Expanding Opportunity through Design:

Recycled rubber is being used by manufacturers in a wide variety of applications today. Manufacturers prize scrap as a raw material input due in part to cost and energy savings.

Here are a number of settings where we see recycled rubber most:

MEDICAL: Hospital floors and surgical gloves
– providing comfort and quiet for medical professionals and patients

AGRICULTURE: Vegetation protectors and windbreaks, sheds, livestock mats, bumpers, and feeders
– increasing yield and efficiency for the agricultural sector

SPORTS: Infill for synthetic turf fields (of which there are more than 12,000 in the U.S.), indoor and outdoor running tracks, and fitness mats
– broadening sports and fitness opportunities across the country

PLAYGROUND SURFACES: Mulch and mats
– cushioning our children's falls

INFRASTRUCTURE: Rubberized asphalt on roadways
– providing surface durability while lessening traffic noise

OTHER: Landscaping mulch, molded products such as railroad ties, flowerpots, garden hoses, benches, and welcome mats
– creating useful everyday products

RecycledRubberFacts.org

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Varied Uses of Recycled Rubber

RecycledRubberFacts.org

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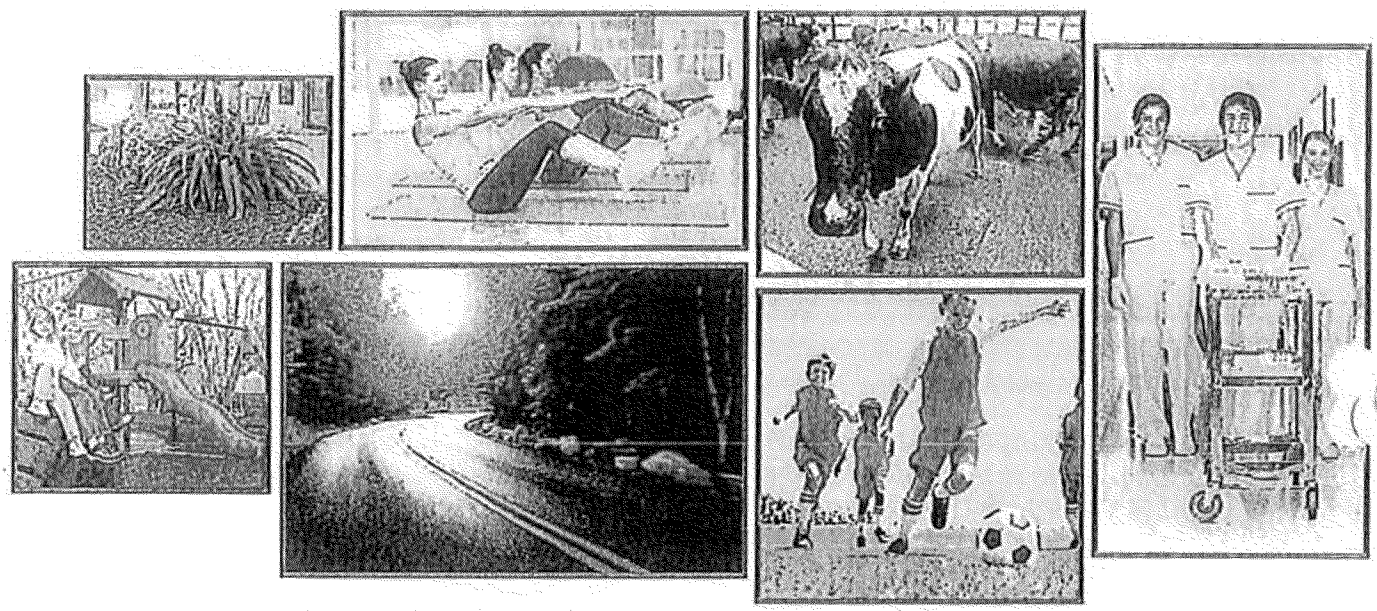

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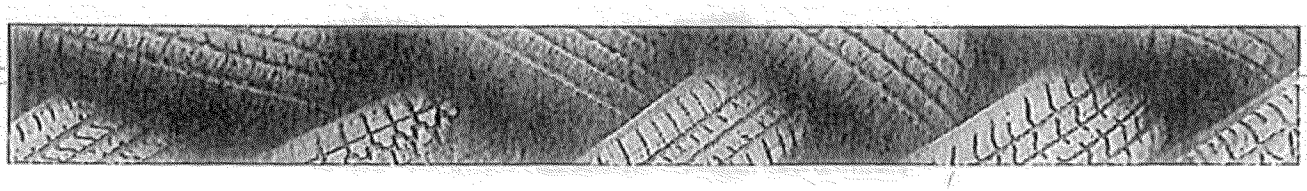
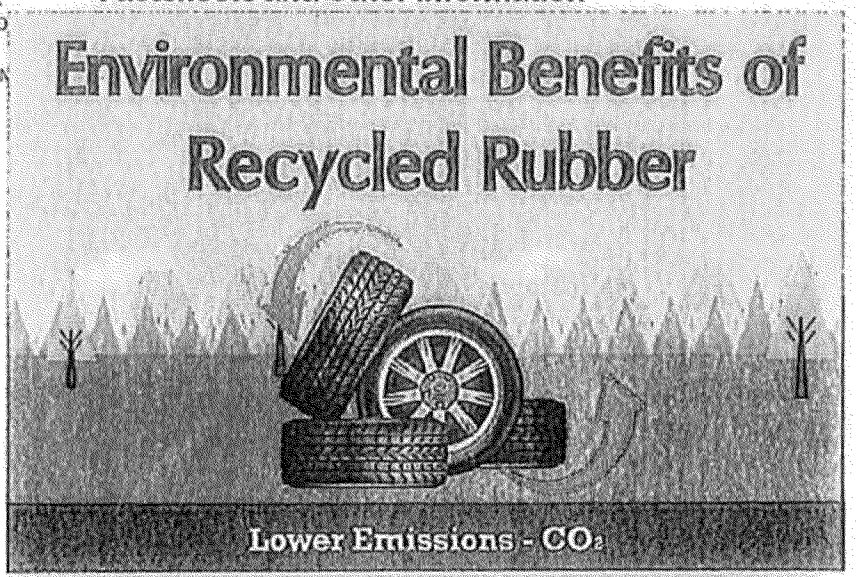
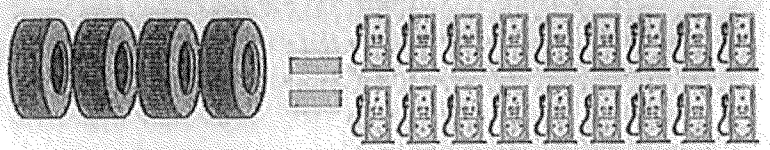


- RECYCLED RUBBER IN THE NEWS
- FACTSHEETS AND OTHER INFORMATIO
- RELATED LIN

Learn More about Recycled Rubber

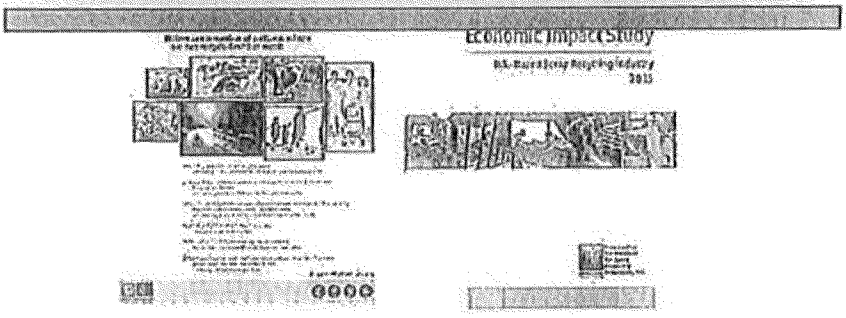
Factsheets and Other Information





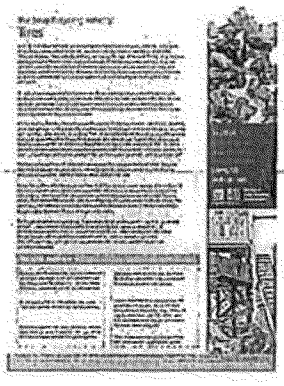
Recycling saves impressive amounts of energy, which ultimately reduces **greenhouse gas emissions**

For example, recycling four tires **reduces CO2 by about 323 pounds,** which is equivalent to 18 gallons of gasoline

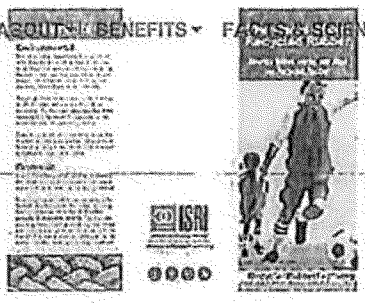


Varied Uses of Recycled Rubber

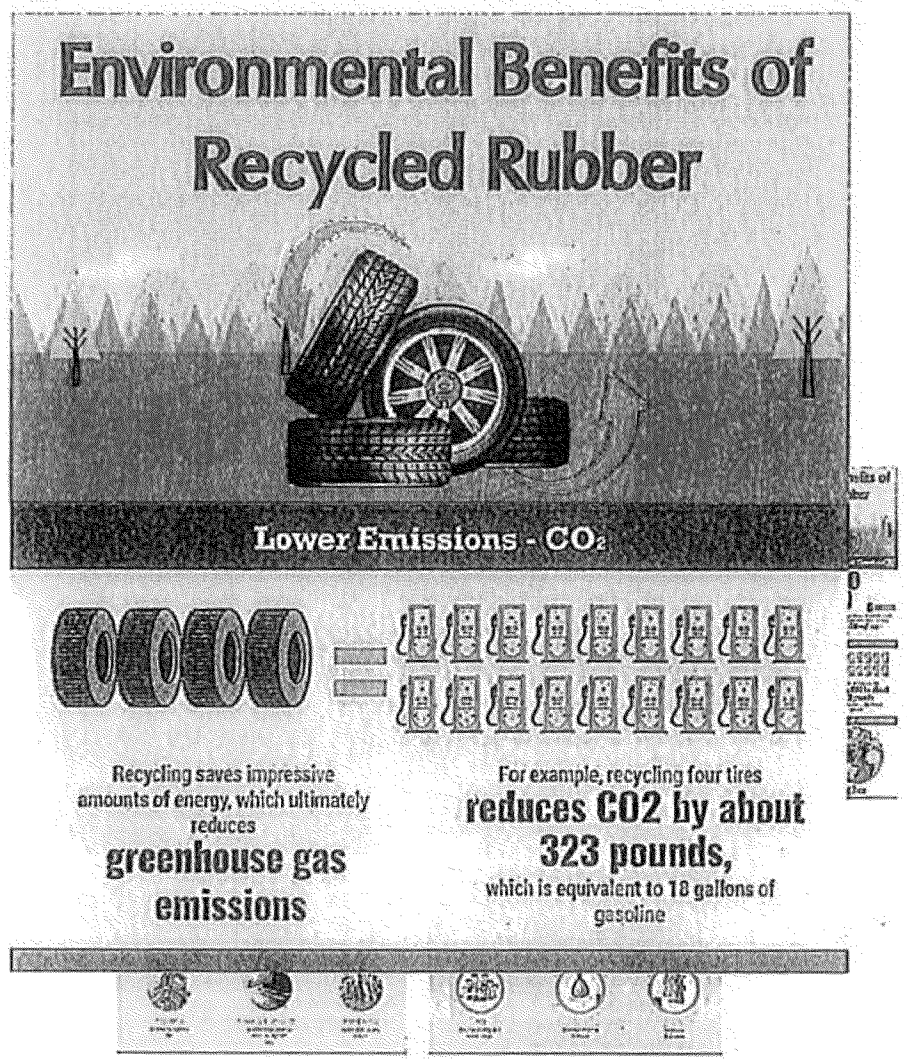
Recycled Rubber Economic Impact Study



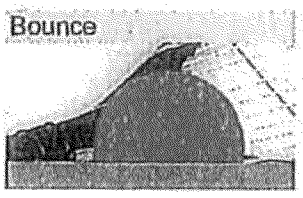
Fact Sheet - Tires

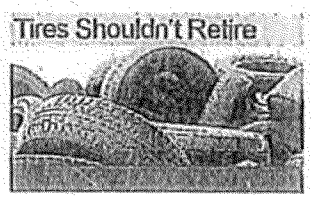


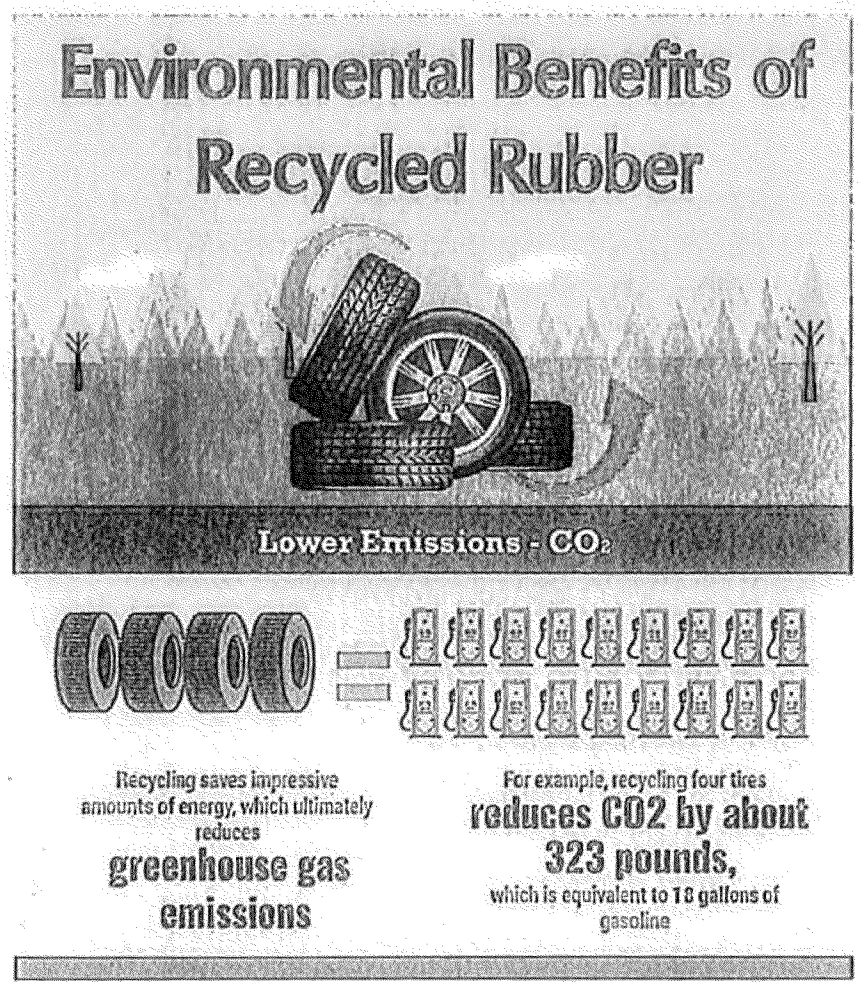
Recycled Rubber Brochure



Student Activities:







RECYCLED RUBBER COUNCIL

Primary Menu

FREQUENTLY ASKED QUESTIONS

Recycled Rubber — Consumer Questions

Q: *What is crumb rubber?*
A: Crumb rubber is a recycled rubber used on turf fields and other flooring throughout the world. Crumb rubber gives turf fields greater buoyancy and flexibility and creates a playing surface that can be used and maintained for decades.

Q: *What is the source of crumb rubber?*
A: Crumb rubber is produced from recycled tires after a thorough process by which tire cords are removed and the rubber is transformed into a safe flooring product.

Q: *Have there been any scientific studies to examine the safety of crumb rubber?*
A: Yes. In fact, over the past 20 years, every study conducted has shown that the use of crumb rubber is not associated with any elevated health risks. These several dozen studies have been conducted by health and environmental agencies in California and Connecticut and at universities such as Penn State.

Q: *Is there any research showing that crumb rubber may be dangerous to children?*
A: No. There is not a single scientific study linking the use of crumb rubber to increased health risks for children or adults.

Q: *What about questions raised by NBC's televised report?*
A: We sympathize with every individual and family mentioned in NBC's story.

However, the story highlighted health concerns that could be related to a multitude of factors both on and off the field, and are extremely unlikely to be related to the use of crumb rubber. As NBC properly noted in their report, "there is no research directly linking crumb rubber exposure to cancer."

Q: *What if my child ingests crumb rubber or it comes into contact with his or her skin?*
A: While people should avoid ingesting crumb rubber, swallowing crumb rubber has not been found to pose any serious health risks. According to a 2010 study by the University of California, ingestion of a significant quantity of tire shred did not elevate a child's risk of developing cancer. A Hoftstra University study in 2007 found similar results and reported that exposure to rubber crumb by swallowing, inhalation and skin contact posed no significant health risk.

Q: *Are children and adults vulnerable to unusually high rates of toxic chemicals in synthetic turf fields?*
A: Extensive research, such as a study conducted by the University of California in 2012, has concluded that synthetic turf fields result in little, if any, exposure to toxic substances. In 2008, the U.S. Consumer Product Safety Commission (CPSC) staff evaluated various synthetic athletic fields. The evaluation concluded that young children are not at risk from exposure to lead in these fields.

Q: *Even if the chemicals in crumb rubber do not affect your health significantly, aren't they still bad to inhale?*
A: Any compounds that enter the air from crumb rubber do not exceed the amount that are naturally present in the air.

Q: *Can I be 100% certain that crumb rubber infill does not cause cancer?*
A: There is absolutely no evidence that crumb rubber infill causes cancer, while more than 60 studies conducted over the past two decades point to the product's safe use.

Recycled Rubber — Buyers and Contractors Questions

Q: *How do I explain to stakeholders that turf with crumb rubber infill is safe?*
A: During the past two decades, there have been more than 60 technical studies and reports that review the health effects of crumb rubber as it pertains to toxicities from inhalation, ingestion and dermal contact, as well as cancer. The preponderance of evidence shows no negative health effects associated with crumb rubber in synthetic turf.

Q: *What about that story about crumb rubber on NBC?*
A: The NBC story featured the concerns of people who are drawing parallels based purely on speculation. NBC noted in their report, "there is no research directly linking crumb rubber exposure to cancer."

Q: *Aren't there safer alternatives to crumb rubber, such as Nike Grind, coconut fiber and cork infill?*
A: A City of Richmond (British Columbia) review found no evidence that the Nike Grind material is safer than the industry standard crumb rubber. And there have been no studies to prove the safety or viability of coconut fiber or cork as infill for synthetic turf, while over 60 studies have been performed regarding the safety of crumb rubber.

Q: *Haven't a lot of communities cancelled their orders for synthetic turf with crumb rubber?*
A: A few communities have delayed their decision until more information regarding health risks could be determined. And many, like the City of Richmond in British Columbia, proceeded with synthetic turf as planned: "Following a staff review of the concerns raised, we are proceeding with the project as planned," said City of Richmond spokesperson Ted Townsend. "The crumb rubber-recycled truck tire product is the present industry standard and we have not been advised of any verified health hazards from using the product."

Rubber Mulch — Consumer Questions

Q: *What is rubber mulch?*
A: Rubber Mulch is a recycled rubber used in playground as a safety surface. The primary purpose of rubber mulch in playgrounds is to prevent critical brain injuries from falls as well as to reduce general injuries from falls to the play surface.

Q: *What is the source of rubber mulch?*
A: Rubber Mulch is produced from recycled tires that have undergone an advanced manufacturing process transforming the recycled rubber into an all-weather playground safety surface product.

Q: *Have there been any scientific studies to examine the safety of recycled rubber as a surfacing?*
A: Yes. In fact, over the past 20 years, every study conducted has shown that the use of recycled rubber is not associated with any elevated health risks. These several dozen studies have been conducted by health and environmental agencies in California and Connecticut and at universities such as Penn State.

Q: *Is there any research showing that rubber mulch may be dangerous to children?*
A: No. There is not a single scientific study linking the use of rubber mulch to increased health risks for children or adults.

Q: *What if my child ingests rubber mulch or it comes into contact with his or her skin?*
A: While people should avoid ingesting recycled rubber mulch, swallowing recycled rubber has not been found to pose any serious health risks. According to a 2010

study by the University of California, ingestion of a significant quantity of tire shred did not elevate a child's risk of developing cancer. A Hoftstra University study in 2007 found similar results and reported that exposure to recycled rubber by swallowing, inhalation and skin contact posed no significant health risk.

Q: *Even if the chemicals in rubber mulch do not affect your health significantly, aren't they still bad to inhale?*
A: Any compounds that enter the air from rubber mulch do not exceed the amount that are naturally present in the air.

Q: *Can I be 100% certain that crumb rubber infill does not cause cancer?*
A: There is no evidence that rubber mulch causes cancer, extensive studies conducted over the past two decades point to the product's safe use.

Rubber Mulch — Buyers and Contractors Questions

Q: *How do I explain to stakeholders that rubber mulch is safe?*
A: During the past two decades, there have been extensive technical studies and reports that review the health effects of recycled rubber as it pertains to toxicities from inhalation, ingestion and dermal contact, as well as cancer. The preponderance of evidence shows no negative health effects associated with rubber mulch in playgrounds.

Q: *What about that story about crumb rubber on NBC?*
A: The NBC story featured the concerns of people who are drawing parallels based purely on speculation. NBC noted in their report, "there is no research directly linking recycled rubber exposure to cancer."

HeraldNet
Everett, Washington

NEWS01
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Preliminary test results: Crumb-rubber in artificial fields safe

By Sharon Salyer
Herald Writer
@NWhealthwriter

EVERETT — Preliminary tests on seven crumb rubber ballfields — including one at the Boys & Girls Club in Everett — have found they pose no unusual safety risks to those playing on them, according to the Cal Ripken Sr. Foundation, which paid for the tests.

But the Baltimore-based foundation also said it will pay for further studies on the material used in artificial turf fields. The group believes the tests will be the most comprehensive conducted so far of artificial turf fields, John Maroon, a spokesman for the organization, said in an email Thursday.

The results are expected this summer. Maroon said the foundation wouldn't have any further comment until later this year. The foundation is named for the famous former Baltimore Orioles manager.

Ken Salem, development director for the Boys & Girls Clubs of Snohomish County, said the organization understands the concerns about crumb rubber.

"Just like all the parents of our kids, we want to make sure our kids are safe," he said. "We await the results of their studies just like everybody else."

The crumb-rubber fill, made from ground up tires, has triggered increasing concern over a possible link to cancer. Last year, the Ripken foundation announced that it would pay for testing on seven fields in response to ongoing national publicity about the issue.

The organization promised to replace all the fields it has helped to pay for if a problem was found. The foundation has helped fund construction of the artificial-turf fields in Everett and at 41 other locations nationally.

The initial tests "have found nothing to raise any concerns," Maroon said. No details were immediately available on the type of preliminary tests that were conducted or more specifics on the results. The tests were completed by Labosport, based in Montreal, Canada.

Material was tested from fields in Everett; Baltimore; Bridgeport, Connecticut; Minneapolis; Newport News, Virginia; Naples, Florida; and Harrisburg, Pennsylvania.

The tested material came from fields chosen for their geographic diversity, including regions of the country with different climates, as well as from fields that were newly installed or built up to four years ago.

The Everett ballfield is on the grounds of the Boys & Girls Club at 2316 12th St., near Hawthorne Elementary School. Installation of the artificial turf, paid for by the Ripken foundation, Everett Community College and Snohomish County Parks and Recreation, was completed in 2014.

The artificial turf replaced an aging grass-and-dirt field. Cost of the new field, including seating, dugouts, bullpens and landscaping, was nearly $1 million.

The Everett Community College womens softball team also uses the field.

Salem said the Boys & Girls Clubs of Snohomish County will "do whatever action we have to, to continue to provide a safe, secure, and healthy environment for our kids."

Crumb rubber sports fields have come under increasing scrutiny both locally and nationally, in part because of the concerns of Amy Griffin, a University of Washington soccer coach. She began keeping track of young adults, mostly soccer players, who played on the fields who later were diagnosed with cancer. That list has now grown to 218 names, she said.

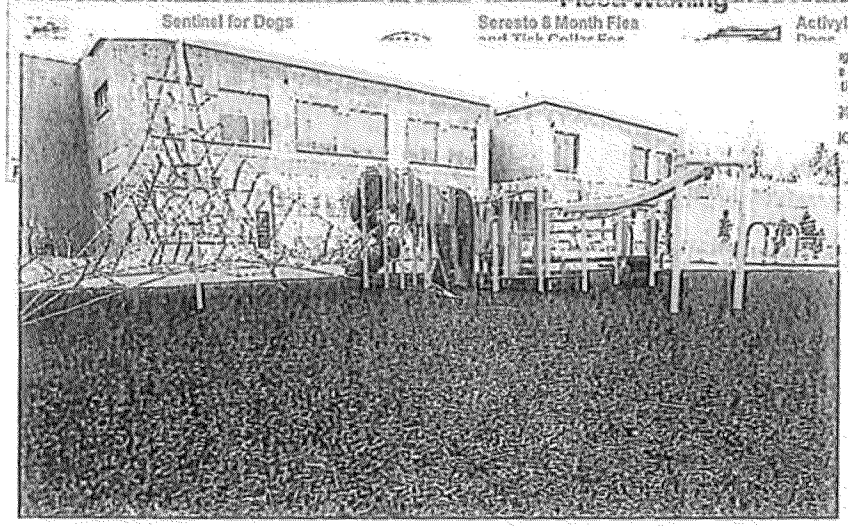
Her questions have led the state Department of Health to begin an investigation of those cases.

A federal investigation of crumb rubber also is under way, led by the Environmental Protection Agency, the Centers for Disease Control and Prevention, and the U.S. Consumer Product Safety Commission.

In Snohomish County, opposition to crumb rubber athletic fields has been greatest in Edmonds. It was triggered by a $4.2 million Edmonds School District project to put two synthetic turf athletic fields at the former Woodway High School. The fields opened in September, but the controversy has continued to simmer, led by parents.

In December, the Edmonds City Council approved a ban on the installation of synthetic turf playfields made from crumb rubber on any publicly owned athletic field until July 11, 2017. The action covers school district-owned properties.

Sharon Salyer: 425-339-3486; salyer@heraldnet.com.



Rubber mulch made from recycled tires covers the playground at Duluth's Lester Park Elementary School. A group of parents in 2015 asked the school district to replace the mulch, citing concerns about chemicals and toxins in the rubber. (File / News Tribune)

Toxicologist's view: Science refutes worries over recycled rubber

By Michael Peterson on Jan 17, 2016 at 12:11 a.m.

Many people are aware of the scare that first surfaced nearly 20 years ago claiming a link between the childhood measles, mumps and rubella vaccine and autism. Although that study was found to be false and officially was retracted by the journal where it was published, media outlets published stories for years using the erroneous data, despite overwhelming scientific evidence showing that vaccines were indeed safe and necessary. Vaccination rates dropped, and outbreaks of preventable diseases rose.

This was not the first public health scare based on scientifically unsound data, and it probably won't be the last. However, it's a great example of the damage that can be done when headlines based on unproven theories replace sound science.

Today, in cities across the country, including in my home state of Minnesota, we face another situation in which unsubstantiated claims are causing parents to worry about their children's safety: namely, the theory that recycled rubber in synthetic turf fields and on playgrounds could cause health issues.

This first surfaced in 2008 but then receded from the public eye when a number of peer-reviewed scientific studies demonstrated no connection between these products and health risks. However, it was revived when NBC Nightly News ran a segment in 2013 (and again in September 2014) implying teenage soccer players were getting cancer from playing on synthetic turf (while noting throughout that there was no evidence of any such connection). Playgrounds with recycled rubber surfaces also have come up in this context.

Recently, this was an issue of concern in Duluth, with a group of parents calling for authorities to take another look at recycled rubber ("Duluth parents raise concerns about rubber playground mulch," Oct. 22).

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In this case, we need to focus on the facts and the available science. As a toxicologist with nearly two decades of experience in human health risk assessment, I have reviewed the available scientific evidence (which includes dozens of studies) and have concluded that, based on this research, recycled rubber does not pose a health risk to children or adults using these surfaces.

The key thing to understand is that the presence of a chemical in a product does not automatically mean it will be harmful. For example, your computer monitor, your iPhone and even the food you eat all contain chemicals that are potentially toxic depending on how much you are exposed to them. The reason these products are considered safe to use is because the exposure is very low.

Health agencies in multiple states (including Connecticut and Massachusetts) have evaluated the exposures to chemicals in synthetic turf infill, and they have, without exception, found these exposures to not be of concern.

In today's world, parents and local decision-makers are right to be vigilant when it comes to the health and safety of children. However, it's important to separate real health risks from those that are not supported by science. Let's hope that reason prevails and that unsupported claims about synthetic turf don't last as long as the vaccine scare.

Michael Peterson is a native of Coon Rapids, Minn., working now in Seattle. He is a board-certified toxicologist for Gradient, an environmental and risk-sciences consulting firm. He also serves as scientific advisor to the Recycled Rubber Council (recycledrubbercouncil.org) (http://recycledrubbercouncil.org).

Forum: Claims about synthetic turf not supported by science

By Michael Peterson

Posted: 11/08/15, 8:53 PM EST | Updated: on 11/08/2015

4 Comments

Many people are aware of the scare that first surfaced nearly 20 years ago claiming a link between the childhood measles mumps and rubella vaccine and autism. Although that study was found to be false and was officially retracted by the journal where it was published, media outlets published stories for years using this erroneous data despite overwhelming scientific evidence showing that vaccines were indeed safe and necessary. Vaccination rates dropped, and outbreaks of preventable diseases rose.

This has not been the first public health scare based on scientifically unsound data, and it likely won't be the last. However, it's a great example of the damage that can be done when headlines based on unproven theories replace sound science.

Today, Connecticut is at the center of another situation in which unsubstantiated claims are causing parents to worry about their children's safety: namely, the theory that crumb rubber infill in synthetic turf fields and playgrounds could cause health issues.

This issue first surfaced in 2008, but then receded from the public eye when a number of peer-reviewed scientific studies demonstrated no connection between these products and health risks. However, it was revived when NBC Nightly News ran a segment last year (and again in September) implying teenage soccer players were getting cancer from playing on synthetic turf (while noting throughout that there was no evidence of any such connection).

Recently, this has become a local issue of contention in several Connecticut towns, including Bristol, Hartford, Middletown, and Plainville. Since decisions regarding what kind of field to use at local schools are made at the town level, the concerns raised by the NBC story have led to petitions, contentious Town Council and Board of Education meetings, and left many parents searching for answers.

Connecticut itself has been one of the most vocal states on the safety of crumb rubber. Four state agencies came together to conduct a thorough study of the issue, which was peer-reviewed by the Connecticut Academy of Science and Engineering. This work, along with dozens of other peer-reviewed scientific studies and papers from other states, was enough for Connecticut — which even issued a public letter reaffirming its position last year following the NBC report.

So why is this still an issue?

One reason could be a recent report released by a North Haven-based group, Environment & Human Health, Inc. In June of this year, EHHI issued a press release announcing the results of an experiment it said identified a number of carcinogens in crumb rubber infill.

As a toxicologist with nearly two decades of experience in human health risk assessment, I do not believe that this EHHI study provides any scientific evidence that synthetic turf infill poses a risk to children or adults using these surfaces. It has not been peer-reviewed — a critical aspect of the scientific process — and I have not been able to identify the methods used or the actual data referenced on the group's website. This type of information is important so other scientists can review and critique the appropriateness of the methods and insure the data have been interpreted correctly.

Nevertheless, with the information on their website, it is possible to determine that this study does not provide data that are useful for evaluating the actual health risk from these fields. The presence of a chemical in a product does not automatically mean it will be harmful. For example, the computer monitor you are (likely) looking at right now, your iPhone, even the food you eat, all contain chemicals that are potentially toxic depending on how much you are exposed to them. The reason these products are considered safe to use is because the exposure is very low. Health agencies in multiple states (including Connecticut) have evaluated the exposures to chemicals in synthetic turf infill, and they have without exception found that these exposures are not a concern.

In today's world, parents and local decision makers are right to be vigilant when it comes to the health and safety of children. However, it's important to separate real health risks from those that are not supported by the science. Let's hope that reason prevails, and that unsupported claims about synthetic turf don't last as long as the vaccine scare.

Michael Peterson is a board-certified toxicologist at Gradient, an environmental and risk sciences consulting firm. He serves as scientific adviser to the Recycled Rubber Council.

OPTIMAL PERFORMANCE
SUPERIOR VALUE

USA Today Sports - Fields of Green: Synthetic Turf Comes Under Fire But Lack of Proof Makes It a Preferred Playing Field Surface

Posted October 9, 2015

Synthetic turf using crumb rubber has come under attack from the Women's World Cup and now an updated NBC news report is questioning whether the recycled rubber used in the turf is causing health problems. Without further research, the benefits of field turf — at least in regards to the environmental and business considerations — outweigh the supposed risks. Synthetic turf provides a consistent playing field that allows municipalities all the way up to professional teams to deal with cost certainty, player safety, and environmental concerns.

The Women's World Cup was the first time a major sporting event even discussed the turf issues. Artificial turf was the main surface in the tournament hosted in Canada. The answer was simple, grass turf can't grow easily in Canadian conditions, and it wasn't cost effective to have temporary grass surfaces. Although there were multiple complaints before the tournament, it ended up being overblown. The quality of the play was still solid and that was reflected in the ratings.

Now a NBC report reignited questions about the health concerns of playing on fields primarily made up of crumb rubber. The report cites over 60 soccer players stricken with cancer, and questions whether it is because of the turf. It is important to note that according to US Youth Soccer, over 3 million participants played in the U.S. in 2014, and many of those participants are playing on synthetic turf fields.

Currently there is no proof that synthetic turf led to the types of health concerns NBC addressed. NBC even mentions the lack of proof in its own report. Dr. Laura Green, a MIT-educated toxicologist, is quoted saying, "There's zero reason to be concerned that playing on synthetic turf will put your child at risk for cancer. It's simply not true." There is also a study by the state of Connecticut which did not find any elevated cancer risks from playing on turf.

In response to the NBC report, the Recycled Rubber Council, an industry group, contended that, "we unequivocally stand behind these products and we would not put our children and grandchildren on fields or playgrounds with crumb rubber if they were hazardous."

For minimal risks, field turf with crumb rubber provides a number of benefits. Environmentally it is just a stronger alternative to natural grass. With much of the country experiencing drought conditions, field turf allows cities and towns to save water that would have to be used on upkeep. Natural grass also

requires heavy treatment with fertilizers that have proven health risks. This doesn't even consider the amount of field paint –again filled with chemicals — needed to keep the field of play delineated.

Field turf is also a sound investment. It is cheaper than natural grass and that cost savings is important, especially with many city and state governments going through debt problems. It also allows local governments to create multi-purpose fields that can be used on back-to-back days for a range of sports. The EPA should look into the issue, but with all of the information we have now, it doesn't make sense to start banning field turf with crumb rubber for less efficient grass fields.

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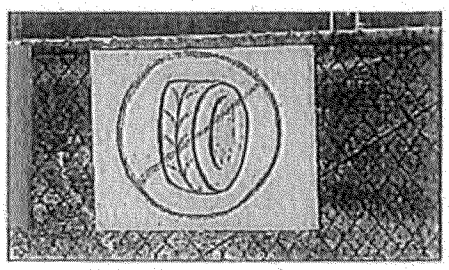
Verdant consultant: Available data shows no risk from crumb rubber fields

May 27, 2015



A sign made by opponents of tire crumb rubber turf.

Following up on public concerns expressed about a plan to install an artificial turf field at the former Woodway High School, the Verdant Health Commission at its meeting Thursday morning released the results of a 23-page review of turf field safety, prepared by environmental and risk sciences consulting firm Gradient.

The firm's conclusion: Based on the the current publicly available data, chemical levels found in two types of artificial turf that have been considered for the Woodway project — FieldTurf SBR made of rubber tire crumbs and GeoTurf infill made mainly of coconut fibers and sand — do not present a risk to people playing on or using fields with these products. Gradient also had been asked to review findings for a third option that had been considered — "Nike Grind" material from a Nike-sponsored shoe recycling program — but did not receive information in time to include it in the report for Wednesday's Verdant Commission meeting.

The findings "are consistent with those of multiple regulatory agencies that have evaluated the risk from artificial turf products in general," the Gradient report said, "including evaluations that are more complex than this screening level assessment. Although there are limitations with a screening level risk assessment such as this one, the consistent conclusion that the data do not indicate an increased risk of health effects from chemical exposure lends additional support to our conclusion."

You can read the entire report here.

Among those present to hear the results of the report at Verdant's Lynnwood office Wednesday morning were representatives from a group of parents and neighbors who have opposed installation of the tire crumb artificial turf, which has been linked to media reports of possible cancer concerns. Group representatives have spoken at a variety of school district and city meetings, urging the district to look at other turf or natural grass options. But despite opponents' efforts, both the city council and the school board in recent weeks have taken votes that have moved the fields project forward. (See our report here on an

appeal filed last week in Snohomish County Superior Court challenging the city's land use decision regarding the project.)

"We appreciate the staff and board of Verdant taking the time to thoughtfully respond to the concerns raised by hundreds of community members about crumb rubber," said group spokeswoman April Osborne. "We felt they honestly and transparently went through an investigative process and shared their findings openly with the public. Throughout the process, Verdant staff answered emails and demonstrated a great deal of respect and integrity in the way they dealt with our concerns and communication."

Osborne said the results of Gradient's report came as no surprise to the turf opponents. "Studies are limited, and the consultant hired by Verdant to analyze them came back with an appropriate conclusion based on what is currently available," Osborne said. "On behalf of the board, Fred (Langer, Verdant Commission Board President) expressed a willingness to continue the conversation, and acknowledged that as more research is done, Verdant remains open to hearing about it."

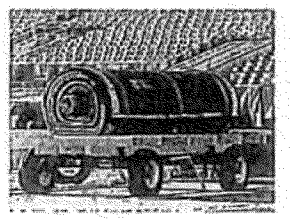
Verdant Commission Superintendent Carl Zapora said last week that Verdant is committed to the $2.5 million it has already granted for the multi-use fields project, and that the final decision on which type of turf to use will be up to the school district. But he did leave the door open to the possibility that Verdant could provide additional money to cover the cost of a more expensive type of artificial turf, if the school district made such a funding request. Osborne said that Langer reiterated Wednesday that "should the Edmonds School Board request money for an alternative infill product, the Verdant Board would be very open to discussing the idea."

Added Osborne: "On behalf of all our children, we will continue to call for more research into the dangers posed by crumb rubber turf, and we appreciate Verdant's willingness to engage in dialogue and their willingness to continue the conversation."

Ground up tires give new meaning to synthetic turf

Gary Mihoces, USA TODAY Sports 5:57 p.m. EST January 9, 2014

Environmentalists dispute an EPA study that ground up tires in turf pose no health risks.



(Photo: Julio Cortez, AP)

For each vehicle that gets a new set of tires, the old ones must go somewhere.

Instead of creating a fire hazard by piling them at unsightly dumps, some ground up tires are used as filler on synthetic turf sports fields and ground cover at playgrounds -- including MetLife Stadium in New Jersey, home to the NFL's New York Giants and Jets and the upcoming Super Bowl.

Such usage is a win-win proposition and recyling at its best, according to those in the industries involved, who also note synthetic turf doesn't require water, fertilizer and pesticides. But there are some critics who warn that tire materials contain toxic substances and carcinogens that might pose health risks for athletes and kids.

At the center of the debate are the federal Environmental Protection Agency (EPA) and a Washington, D.C., non-profit group that represents local, state and federal employees in the environmental field.

"This issue was brought to us by EPA scientists," says Jeff Ruch, executive director of Public Employees for Environmental Responsibility (PEER). "They were sort of appalled with what the agency was doing.

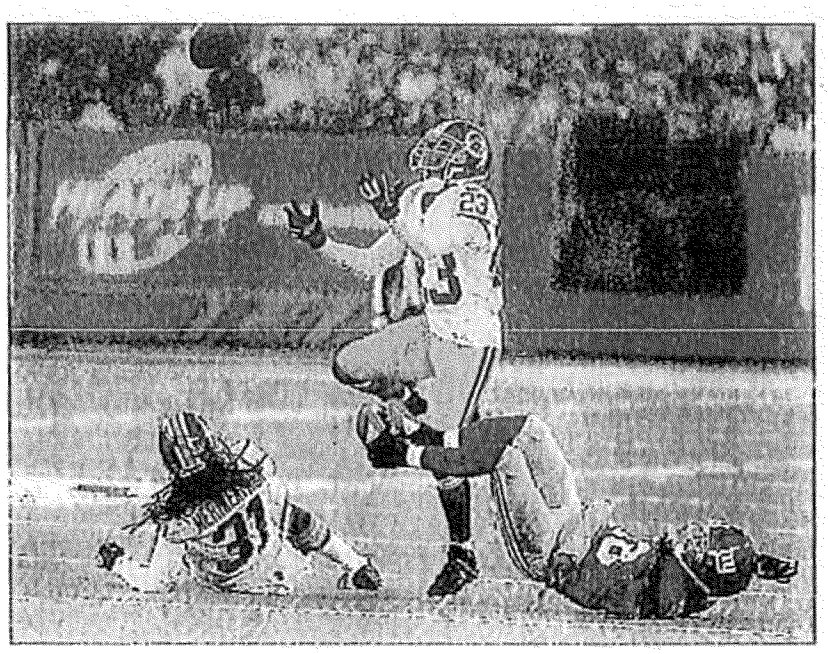
"You've got the solid waste people saying, 'Look, if it's recycled, it's good, so we're solving an environmental problem by taking tires out of the landfill.' And the scientists are saying, 'Gee, is that a good idea? What about the people that are exposed to it?'"

Ground up tires -- "crumb rubber" in the lingo of the industry -- can be processed into black granules that resemble sesame seeds and used with san "infill" under the turf fibers.

MetLife Stadium went with a new synthetic turf field last summer. The Speed Series S5-M surface, made by UBU Sports of Dalton, Ga., uses sand and crumb rubber infill and, the company says, "ensures a fast, firm and safe playing field." Last year's Super Bowl at the Superdome in New Orleans was played on the same synthetic turf.

Brian McCarthy, NFL vice president of corporate communications, expressed no reservations about the turf and tire particules.

"It's our understanding that someone would have to eat the turf or be run over by a tire to be injured. ... There's no concern," McCarthy told USA TODAY Sports.



etLife previously had FieldTurf, which also used ground tires. Why the switch?

"Time for a new surface after three full years," McCarthy says. "Keep in mind they have two NFL teams there, concerts, soccer, monster truck events, etc, plus to get ready for the Super Bowl."

UBU Sports, in a fact sheet on the new MetLife turf, says 200 tons of crumb rubber infill was used: "That saves 36,504 tires from landfills, which is enough for 9,126 cars."

Nick Vlcek, a spokesman for UBU Sports, says of the health concerns: "I do know that the EPA released a statement a few years ago ... that crumb rubber is safe."

In a study published in 2009 by the EPA, the agency said in its news release that "limited field monitoring" found a "low level of concern."

The study and release remain on the EPA website.

But last month, after a request by PEER that it rescind the study and the release, the EPA instead added a notification to the original 2009 release on its website: "This news release is outdated. Visit the EPA Tire Crumb Study Web Page for the most current information."

The section of the Tire Crumb Study Web Page addressing the study says, "Given the very limited nature of this study ... and the wide diversity of tire crumb material, it is not possible ... to reach any more comprehensive conclusions without the consideration of additional data."

The web page lists 30 compounds or materials that might be found in tires, although not all are in every tire. They are listed alphabetically, from acetone to trichloroethylene. One line the EPA dropped from the original web page: "On average the concentrations of components monitored in this study were below levels of concern."

. its request to the EPA to rescind its study, PEER wrote, "Many of these chemicals are carcinogens and can have a negative effect on humans' nervous ,ystems, reproductive systems, dermal (skin) systems, ocular (eye) systems, or immune systems."

Says Ruch: "Up until this happened, the industry has been representing EPA as basically endorsing the product as safe. So that stamp is now withdrawn."

Dan Zielinski, senior vice president, public affairs, of the Rubber Manufacturers Association (RMA), says he doesn't "by any means" consider it an EPA retraction: "They're just sort of reiterating, which they said initially, that those studies were very limited in nature."

In August, the RMA released a review of studies of crumb tires, prepared by the Pittsburgh division of Cardno ChemRisk. That review found "no adverse ... health effects are likely to result from these beneficial reuses of tire materials," but acknowledged that "additional research" would be helpful.

Nancy Alderman, president of Environment and Human Health, Inc., a non-profit based in New Haven, Conn., says her group has campaigned for years about the "toxicity of rubber tires."

She says, "There are certain things that shouldn't be recycled: asbestos, lead and ground up rubber tires. I mean, these are hazardous commodities."

Carcinogen found at N.J. high school baseball field

Lawrence baseball players do some post game field grooming in this file photo. *(Martin Griff | Times of Trenton)*

By Cristina Rojas | For NJ.com
Email the author | Follow on Twitter
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LAWRENCE — High levels of the carcinogen benzopyrene were found in a section of the varsity baseball field at Lawrence's middle and high school campus, prompting the district to order additional soil testing on all of the playing fields.

The district announced Friday that soil samples taken from the baseball field tested positive for benzopyrene above the allowable limits. The extent of the problem is still being determined, but benzopyrene is a carcinogen found in cigarette smoke and auto exhaust.

"Any time we have any contamination, there's a concern of course," business administrator Tom Eldridge said. "We know it's not the whole field because we took multiple tests on that field and not every test came back positive. Only one area did, so now we want to know just how big that area is."

Testing of soil samples from the other fields on the 52-acre campus is ongoing and those results are expected in about two weeks, Eldridge said.

PLUS: Brunswick Pike redesign to finally start

The soil tests were initially done as part of the $3.6 million project to install synthetic turf on the varsity baseball and football fields, which will allow them to accommodate multiple sports.

"We know the inevitable contractor will have to have these soils tested so we wanted a level of certainty" before awarding a contract, Eldridge said. "We didn't want to find out after the fact that we had an issue."

The baseball field will remain closed and that portion of the project delayed until the contaminated soils are remediated. The district, however, will move ahead with the turf on the football field since no reportable substances were found.

Eldridge said a bid could be awarded as early as April or May and construction could be completed by the end of the summer.

A decision still hasn't been made on the type of infill that will be used on the fields. Crumb rubber infill is the most common material used in turf fields, but after concerns were raised about possible health risks, the district is considering alternatives such as cork and coconut, Eldridge said.

The hard costs for the two fields is expected to cost about $3.1 million, but the alternate bids could bring the total up to $3.6

million, which is the amount that has been allocated for the project.

One of the options being pursued is lighting, which officials say would provide as much playing time as possible to students and residents alike.

Since work on the baseball field is indefinitely delayed, Eldridge said the district is looking into shifting some funds to install lighting at the football field.

"If we can light the field, we will light the field," he said. "If we don't (have the funding), then we can't."

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